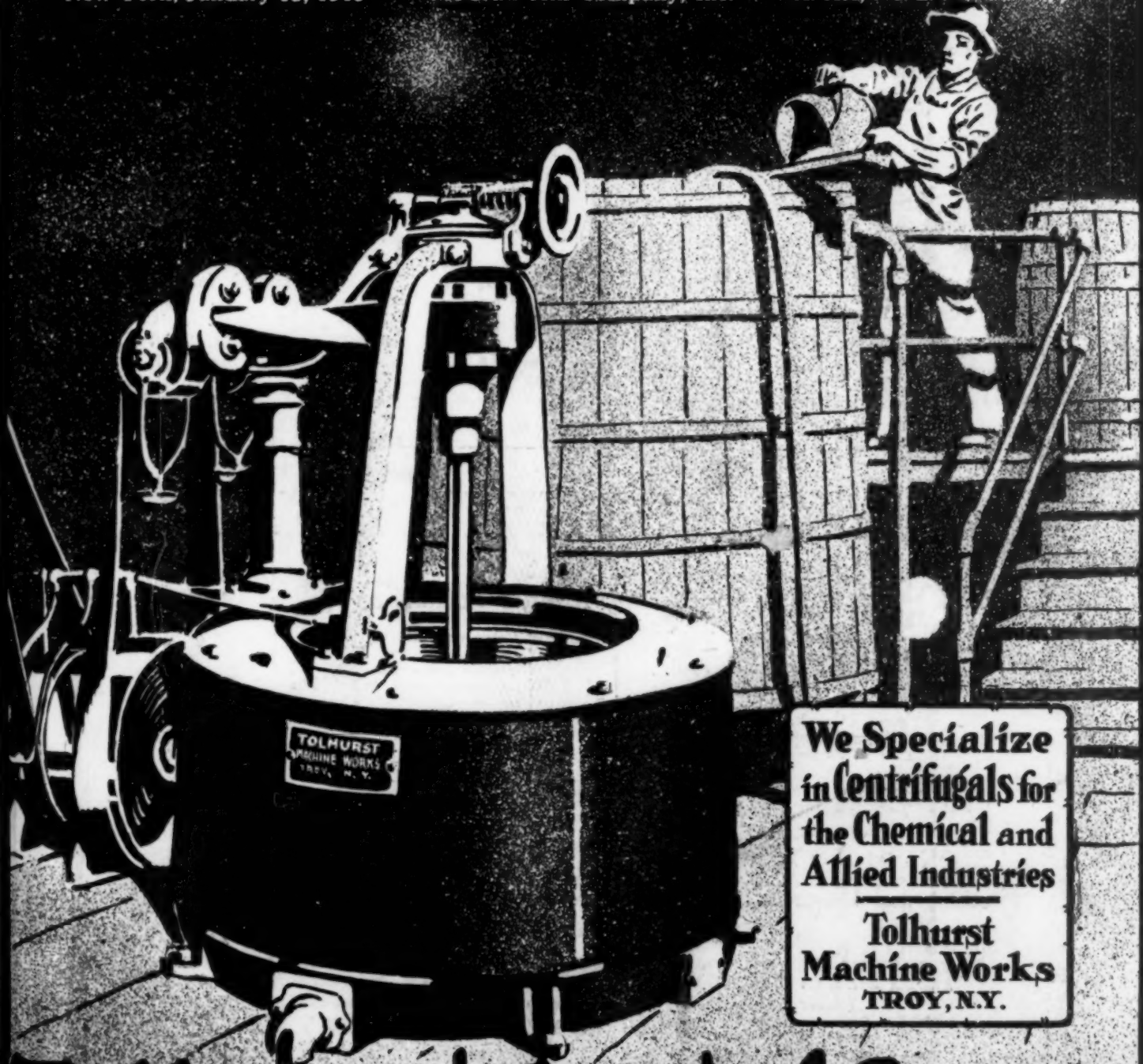


CHEMICAL & METALLURGICAL ENGINEERING

New York, January 15, 1919

McGraw-Hill Company, Inc.

Vol. XX, No. 2. 25c a copy



**We Specialize
in Centrifugals for
the Chemical and
Allied Industries**

**Tolhurst
Machine Works
TROY, N.Y.**

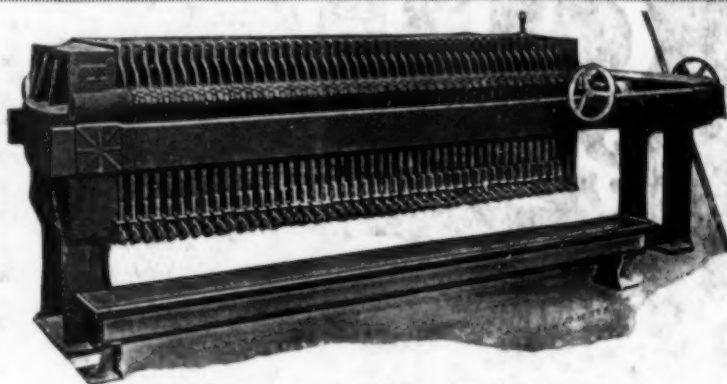
Tolhurst Centrifugals

**For Big Production and Low
Operating Cost
SHRIVER
FILTER PRESSES**

They increase output and effect marked savings in filter cloth replacements and the recovery of values. Little attendance and less wash water adds to their economy.

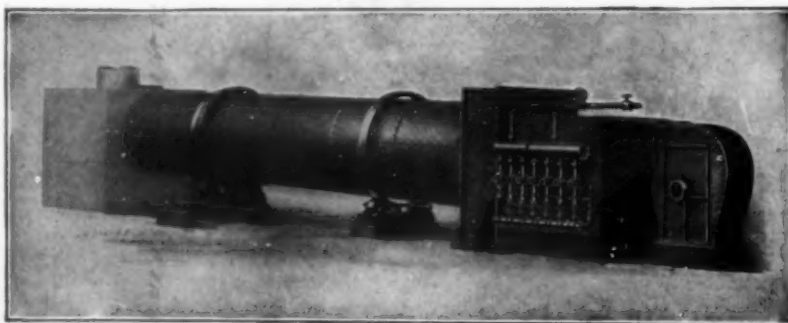
Have wide joint surfaces. Accurate finishing of plates and frames, coupled with an efficient tightening device, prevents leakage.

Presses for all industrial filtration. Small presses for laboratory work.



T. Shriver & Co., 808 Hamilton St.
Harrison, N. J.

STEAM HEATED AIR DRYERS



for drying Borax, Nitrate of Ammonia, Baking Powder, etc.

Have equipped largest chemical plants in the world.

Also Direct Heat Dryers for By-Products.

Material carried in stock for standard sizes.

American Process Co.
68 William St., New York

WHEN IN THE MARKET

**Don't Forget that We Supply
the Following Metals and Alloys**

Ferro-Titanium, 25% Ti
Chromium, 98-99% Cr.
Ferro-Chromium, 60% Cr.
Ferro-Vanadium, 40% Va
Ferro-Molybdenum, 80% Mo
Cobalt, 97%
Tungsten, 95%
Ferro-Tungsten, 70%

Manganese, Pure
Manganese-Copper, 30/70%
Manganese-Titanium, 30% Ti
Manganese-Aluminum, 25% Mn
Phosphor-Copper, 1% Phos
Silicon-Copper, 10% Si
Phosphor-Iron, 5% Phos
Nickel-Copper, 50-50%

We are also in a position to quote on 50% Electro Furnace Ferro-Silicon manufactured by the Keokuk Electro Metals Company, of Keokuk, Iowa. This plant is now turning out a very high grade alloy, and, being centrally located, offers superior shipping facilities and freight rates. We represent this Company as exclusive selling agents.

Foundries making Brass, Bronze, German Silver, Nickel, Aluminum or composition castings should be sure to investigate our Pure Manganese and Manganese Alloys.

Ask for our pamphlet No. 2041.

METAL & THERMIT CORPORATION

(Successors to Goldschmidt Detinning and Goldschmidt Thermit Co.)

THE EQUITABLE BUILDING, 120 BROADWAY, NEW YORK

Chicago—7300 So. Chicago Ave.
San Francisco—329-333 Folsom St.

Pittsburgh—1427-1429 Western Ave.
Toronto, Ont.—103 Richmond St., W.

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of ELECTROCHEMICAL & METALLURGICAL INDUSTRY and IRON & STEEL MAGAZINE

McGRAW-HILL COMPANY, INC.

Tenth Avenue at 36th Street
NEW YORK

JAMES H. McGRAW, President

ARTHUR J. BALDWIN, Vice President E. J. MEHREN, Vice President
EDWARD CALDWELL, Treasurer JAMES H. McGRAW, JR., Secretary

TELEPHONE, 2840 Greeley. CABLE ADDRESS, Machinist, New York

WASHINGTON, 1410 H. St., N.W. SALT LAKE CITY, Newhouse Bldg.
CHICAGO, Old Colony Bldg. PHILADELPHIA, Real Estate Trust Bldg.
SAN FRANCISCO, Rialto Bldg. CLEVELAND, Leader-News Bldg.
LONDON, Hastings House, Norfolk St., Strand.

H. C. PARMELEE, Editor
ELLWOOD HENDRICK, Consulting Editor
ERNEST E. THUM, Western Editor
WALLACE SAVAGE, Assistant Editor

J. MALCOLM MUIR, Manager

Yearly Subscription price for United States, Mexico, and United States dependencies, \$3; all other countries, \$4. Single Copy, 25c. When change of address is ordered, the new and the old addresses must be given. Notice must be received at least 10 days before change takes place. No back copies for more than three months.

Copyright, McGraw-Hill Co., Inc., 1919. Entered as Second-Class Matter at the Post Office at New York, N. Y., under the Act of Congress, July 1, 1918.

Circulation of this issue 11,600 copies

CONTENTS for January 15, 1919

Volume 20, Number 2

EDITORIAL	
The Outlook of the Optimist.....	49
Faith in Our Friends and Allies Across the Atlantic.....	50
Scrutable in the Penultimate.....	50
Capacities Well Aligned in the Iron Industry.....	51
READERS' VIEWS AND COMMENTS	
Ferromanganese. By A. R. Balcom.....	52
Colloids in Flotation. By Jackson A. Pearce.....	52
An Analysis of Ferromanganese. By L. R. Taylor.....	53
That Missing Page From the Blue-Back Speller. By E. A. Driscoll.....	53
Rossiter W. Raymond.....	54
Western Chemical and Metallurgical Field.....	55
Industrial Efforts in France During the War. By Georges Maussa.....	56
Phosphorus in Copper Alloys.....	58
Notes on Electrical Precipitators. By Ernest Edgar Thum.....	59
Ramsey Memorial Fund in America.....	64
Furnace Settings for Caustic Pots. By Frank H. Nickle.....	67
Platinum Economy in the Industrial Laboratory. By E. C. Mueser.....	69
Dyes and Other Coal-Tar Chemicals.....	70
An Example of Crystal Crushing.....	72
Electric Furnaces in the Steel Industry and Their Relation to the Central Station.....	73
Disposition of Munitions.....	76
Separation of Potash Salts. By H. P. Bassett, Ph. D.....	76
Distillation of Coal at Low Temperature.....	78
Chrome Sands on the Pacific Coast. By Justice F. Grugan.....	79
Canadian Graphite Industry.....	81
Minor Occurrences of Mercury in Europe. By Dr. Roland Sterner-Eatner.....	82
Engineering Research in Chemical Organizations. By Crosby Field.....	84
Recent Chemical and Metallurgical Patents.....	86
Synopsis of Recent Chemical and Metallurgical Literature.....	88
Reinforced Waterproof Paper.....	90
Book Reviews.....	90
Personal.....	90
Obituary.....	91
Current Market Reports—Non-Ferrous Metal Market, the Iron and Steel Market, the Chemical Market and Chemical Price List.....	91
Industrial News—Plant Construction, Catalogs and New Publications.....	95

The Outlook of the Optimist

NOW is the time to be optimistic. And we will be if we are thoughtful, for it is mainly the thoughtless and heedless who comprise our minority of alarmists and pessimists. Our country has just completed the most gigantic task ever set for it since the day when it achieved political independence. By the same token it faces, with the other great nations of the world, the most momentous problems in human history. Having been successful in overcoming the military forces of the enemy by performing stupendous tasks of organization and production, are we to face less resolutely and with less hope, confidence and courage the problems of government, of labor, of food, of production and distribution, of demobilization and reconstruction?

Let us think for a moment and try to realize conditions that are average and general instead of those that are isolated and specific. The pessimist says there is a shortage of this or that. The optimist retorts that the shelves of the world are bare—and he is right. The pessimist says that the Governments of the world have destroyed billions of dollars' worth of material property and that we face ruin. The optimist replies that the people of the world hold securities for billions of dollars, and are richer thereby, with more floating capital and quick assets as buying power than they ever had before. The pessimist sees parts of the world ragged, shabby, hungry, oppressed and distressed. The optimist knows that they are but waiting to spend their money for clothing, food, the necessities and even the minor luxuries of life and that the ideals of the world's leaders promise better conditions for mankind than we have ever known.

For several years we have had unprecedented prosperity. Those who are far-seeing know that the next few years also will be years of plenty. It is merely the gulch, the chasm that lies between these two heights, that gives pause to the thoughtful and brings visions of panic to the thoughtless. The spanning of that gulch can be accomplished just as surely as we raised an army of several million men, just as surely as we turned our industrial machinery from peace to war, just as surely as we raised billions of dollars to support and supply our armies. And we accomplished those things by creating a spirit of confidence in our ability to do them, by uniting the whole country in the thought that although the task was stupendous it nevertheless was feasible.

This is what we must do now with regard to the future. We know that prosperity is just ahead. We must not delay its coming, or rather break its continuity, by becoming alarmed at high wages or isolated

instances of over-supply. Production must be continued and stimulated because there is going to be the demand. We must be glad to see high wages, but we must get an equally high return for them. All standards are higher than they were four years ago—standards of living, wages, production and morals, and there is every reason why they should be maintained on that high level. The need of the world is a new vision, adjusted to the new order. Reconstruction does not mean a return to the old, but an adaptation to the new and best that has grown out of our troubles. Optimism is the order of the day, and the duty of every thinking man is to see clearly and largely and spread the gospel of confidence and our ability to achieve.

Faith in Our Friends and Allies Across the Atlantic

LET'S begin with a parable. Once there was a man who had a son, and the son was a lively boy. He was full of zip and ginger, and as he grew up he displayed great curiosity to know what was going on in the world. Now the father was a cautious man and, knowing the temptations to which all flesh is heir, he admonished the younger one against the many dangers which beset his path. He said to himself that one cannot be too careful, and he watched in secret and listened diligently to whatever reports were brought to him by others, wherefore he was convinced of his son's waywardness even until his suspicions were greater than their warrant. So disagreements arose between father and son and neither trusted the other. And the son persevered in the pursuit of evil, while the father ended his days in sorrow and bitterness.

There was also another man whose son was like unto the first, but the father had faith in him and trusted him. When he was wayward and became entangled in difficulties, his father helped him and sympathized with him, remembering his own early days. Neither would the elder man listen to any evil word that was spoken of him, for, said he, he is mine own son and I should be false to withdraw my faith from him. In the process of time the young man mended his ways and persevered in the paths of righteousness, so that great honors were bestowed upon him. And the twain spent their days in amity and delight. Selah.

Now we have the beginning of another year with victory in our hands, and we may well ask ourselves what we shall do with it. The problems are so many and so great that we are all as little children before them; while the responsibilities are so ponderous that every one who participates in American citizenship has obligations as great as those of a father. What, then, shall we do with this victory? It is not ours alone. Have we earned more of it than our brothers of England, or France, or Italy, or Belgium? We have more of its fruits, but, much as we have paid, our cost has been less than theirs. We cannot deny and we should not forget that for three years they fought our battles. While they were doing this we sold them munitions and thus became the great creditor. Now a great creditor also has obligations like those of a father. Shall we hold fast to our faith in Englishmen and Frenchmen and Italians and Belgians just as we did when our boys were fighting beside theirs? They have borne much and they are sore wounded. They are very likely to

say things and do things and want things that do not seem fair to us. It is excellent to let any one who disagrees talk himself out. Then if we do not respond in anger and thus put him on the defensive, he will not mean everything he has said, after all.

We can carry chips on our shoulders and tell our allies in war that we saved their skins and we can boast and browbeat everybody until we look and sound like so many Germans of the style of 1918. We can incline our ears toward WINSTON CHURCHILL and suspect that Great Britain is resolved to rule the seven seas with a rod of absolute authority and that none but Englishmen may command a ship and none but Scotchmen may operate its engines. There are always enough Fenians and German propagandists running loose to urge us to beware of this hazard that does not exist and never will unless we conjure it up with the help of hate and malice. There are vast possibilities of the development of electrochemistry in France, and because we must hustle to keep our end up in this respect (which is a good thing for us), we can declare that France is more of an enemy than a friend. And then, once our suspicions are well aroused, there's no reason why we should not shiver and fear lest the Belgians be getting ready to eat us up. It would be quite as reasonable. Once we get to thinking along this line it is easy to go on. The Belgians were the ruination of Germany, and Germany was a great nation in her day. Broad is the road and easy the way that leadeth unto trouble.

On the other hand we can keep on believing in our friends across the sea even when things look all wrong and everybody seems disposed to put up tricks against us. Of course we must use our heads and look after our affairs, because things are so ordered in this world. Intelligence is expected. That is the reason guardians are appointed for incompetents. But the main thing is to keep good natured over our job, to make only fair and just proposals and to hold in mind the vast difference between wisdom, which is safe, on the one hand, and shrewdness, which is explosive, and suspicion, which is poisonous, on the other. That second father in the parable knew very well what the boy was up to, but his virtue was that he would not listen to anything that might make him angry. He knew all the time what he was about; but he kept up his faith in spite of everything. That is what we must do.

Scrutable in the Penultimate

THE *Canadian Chemical Journal* takes us severely to task for expressing regret that the president of the Honorary Advisory Research Council of Canada, Dr. A. P. MACALLUM, should hold the opinion that, while it may be inscrutable in the ultimate, there are reasons why international co-operation is inadvisable.

Now the last thing on earth that we want to do is to foment discord, and one of the easiest ways to cause it is to argue that a kindly neighbor who criticises is in error. We do not and did not mean to discourage Canada in research; in our hearts we want to encourage it, but if our Toronto neighbors conclude from our utterances that we indicated a slant toward such discouragement, the best that we can do is to protest our innocence. We want to see Canada among the world's

leaders in science, in the arts, and in the good things of life, with prosperity included.

We have searched our souls in wonder how, if this intimation which we did not mean and cannot see, is present in our comments, it happened to hide itself there. They are keen readers in Canada, and we respect their scholarship, literary as well as scientific. Knowing well how unconscious motives play the very devil with the best of us, we have reached the conclusion that, if the meaning is there, our words may have been tintured with jealousy. We are rather fond of turning phrases ourselves, and we confess that we never thought of the expression "inscrutable in the ultimate" until Professor MACALLUM invented it.

We try to give our readers as fine a chemical and metallurgical journal as there is in the world, but the barriers of speech do encompass us all. And if Canadian professors bring out novelties like "inscrutable in the ultimate," we cannot resist the temptation to use the expression in comment. Nevertheless we maintain certain reservations of conservatism ourselves, for lately we decided not to print an article involving "foremanizing" and "functionalization." At the ruling prices of metals we do not want to strain our type. Nevertheless we would rather buck the antimony market than leave anything unsaid in support of proper modesty, or that might hinder us from the enjoyment of amity among our colleagues.

Capacities Well Aligned in the Iron Industry

THE obvious fact that the steel industry emerges from the war with a much greater plate rolling capacity than existed before the war might suggest that the war disarranged the alignment of capacity in the iron industry as a whole in a number of respects. A scrutiny of the situation indicates, however, that really the industry emerges from the war, with all its intensive and extensive new construction, in remarkably well balanced shape. Claims to the contrary are made, but they come from the commercial rather than the technical ranks. Some merchant blast-furnace men have undertaken to argue that there are not enough blast furnaces to go around and that if the steel mills are called upon to operate at capacity pig iron will command a higher price in the market, in relation to billets, than has obtained in the past.

Considering commercial capacities, ability to produce material under normal and reasonably favorable conditions, the existing pig iron capacity may be taken at 45,000,000 tons a year and the capacity in steel ingots and castings at about 50,000,000 tons. To the uninitiated, possessed merely of a knowledge that pig iron serves the double purpose of making iron castings and making steel, this might seem quite awkward at the outset, but the fact is that "steel production" as commonly reported in the form of ingots merely represents the record of the ingot scales. The material is subject to scaling and shearing, and while the scale is lost in the balance, when it goes through the blast furnace and appears as pig iron production, the scrap goes through the blast furnace and makes its second trip over the ingot scale.

The year 1916 was quite a normal one in respect to operations in the iron and steel industry. There were

39,434,797 tons of "pig iron" produced, of which 32,522,078 were bessemer, basic, low phosphorus, ferro-manganese and spiegeleisen, and 6,912,719 tons were foundry, ferro-silicon, malleable, forge and unclassified. There were produced 41,401,917 tons of steel ingots and 1,371,763 tons of steel castings, making a so-called total "steel production" of 42,773,680 tons. Of finished rolled steel, however, including unfinished steel exported, there were produced only 30,557,818 tons.

The first named, pig iron, 32,522,078 tons, may be considered steel making iron for the purpose of this analysis. It represented 76.0 per cent of the weight of the 42,773,680 tons of steel ingots and castings produced. By the same proportion, 50,000,000 tons of steel ingot and casting capacity at present require 38,000,000 tons of pig iron. With 45,000,000 tons blast furnace capacity there are left 7,000,000 tons of pig iron for gray iron and malleable foundries and puddling furnaces. The amount in 1916 was 6,912,719 tons. That the demand does not grow as does the demand for steel products is indicated by the fact that the corresponding amount in 1910 was 6,748,886 tons.

This makes a clear case that according to precedents there is no shortage of pig iron in prospect, but there are two other facts which indicate that if there is any disturbance in the balance it is in the other direction. In 1916 the United States exported 212,765 tons of scrap and 607,236 tons of pig iron. It can hardly be maintained that, from an economic standpoint, we ought to export those materials. Why not export iron ore, also coke, or, better still, coking coal? The second fact is that the present new construction program involves about 1,000,000 tons of steel ingot capacity and materially more than 1,000,000 tons of pig iron capacity, whereas 760,000 tons of pig iron would take care of 1,000,000 tons of steel ingots.

These computations are not conclusive as to what will occur. What they do show is that there is no basis at present for concluding that pig iron will be scarce relative to steel or that it will be particularly plentiful relative to steel. When it comes to the test, under favorable conditions, blast furnaces, steel making departments and steel rolling departments are all more or less likely to exceed their ratings or break previous records, and no one can tell which department would come out ahead in the race.

As to there being a proper balance at this time between steel making and steel rolling and finishing capacity the case is not so clear. Throughout the war, it is true, rolling capacity was found for all the ingots produced, even the altogether unconventional ingots produced in steel casting plants as a war-time measure, but there was much shell steel produced, with little rolling, much of it passing to the forge shop in large sections. An abnormal tonnage of plates was produced, but such a tonnage will still be required. If, however, any shortage of rolling capacity develops it can be remedied much more readily than a shortage of pig iron or steel making capacity.

Thus the iron and steel industry is well balanced within itself. Whether it is well balanced against commercial demand for the product, when its capacity is 114 per cent greater than the output in 1906, an extremely good year in its time—that is another story, on which the future will throw light in due time.

Readers' Views and Comments

Ferromanganese

To the Editor of Chemical & Metallurgical Engineering

SIR:—I observe in the Dec. 15 number on page 794, under the heading of "Missing Page From the Blue Book Speller," your article on the subject. You certainly could not hit the target and ring the bell better than you did in this article. I will endeavor to answer the question that you mention.

If manganese ferro-alloy is dropped into an empty hot ladle and the ladle then filled from the crucible of steel, the mixture will be perfect, as it requires between ten and forty seconds to completely fuse the manganese ferro-alloy. I find that this method makes a stronger casting and absolutely no segregation takes place.

A. R. BALCOM.

Toronto, Canada.

Colloids in Flotation

To the Editor of Chemical & Metallurgical Engineering

SIR:—In an article entitled "Colloids in Flotation," *Mining & Scientific Press* of Oct. 12, I endeavored to explain some vagaries of the flotation process. In your issue of Nov. 15, Mr. A. Schwarz has dissected the article and subjected its author and his profession to some abuse for calling a certain substance colloidal matter. I am offering no apologies for having written the article, but would like to clarify certain points that received a broadside of condemnation.

The statement that I had "written with a total ignorance of the actual meaning of colloid chemistry" was clearly ill advised in view of the opening statement of my article in these words "the very fine amorphous material in crushed ore usually spoken of as colloids or colloidal matter." Colloidal matter is a term used in the absence of a better one for this particular substance. It is fine, amorphous, difficult to settle, hard to filter out, sometimes passing through the filter very much as does the water to which it imparts a velvety sheen. That it may contain colloids is recognized by the United States Bureau of Mines¹ which notes the presence of such colloids as kaolin, iron, aluminium hydroxide, tungstic acid, molybdic acid; and more particularly colloid silica as noted by Courtenay De Kalb² in this statement, "Common hydrophilic colloids are soaps, gelatin, albumin, casein, and silicic acid. The last is produced in mill pulp as a result of attrition on the ore. The longer and the more finely the ore is ground the larger will be the hydrophilic gel-colloid present in solution." Whether these colloids are flocculated or not the subject under discussion can be referred to, even in the presence of granular material, as colloidal matter without necessarily being ignorant of the meaning of colloid chemistry. It is interesting to note that the conclusions reached in technical paper No. 200 of the United States Bureau of Mines are almost identical with those stated in my article as to the deleterious effects of colloids in flotation. Here are the two conclusions, and it matters but little which you take. "If a considerable amount of

colloidal material is present, its elimination, or at least the elimination of its effects, will be necessary," and "the elimination of all, or nearly all colloidal matter very likely would end most of our flotation troubles."

Mr. Schwarz proceeds to tell us that "beyond all question of doubt the flotation process is absolutely fundamentally based upon the colloids from oils, tars, intermediate products, and the like used." That may or may not be so, but we do know that oils, tars, and coal tar intermediates are not necessarily effective agents in selective flotation. They may be effective frothing agents, but the production of froth is not necessarily effective flotation. I have seen froth a foot deep that carried relatively less mineral than the original ore. In my work on feldspathic ores I have reduced the froth from a cross-section area of 300 sq.in. to 2½ sq.in., and thereby increased the recovery 100 per cent. Froth is not sufficient in itself, nor is a colloid. If a colloid were sufficient, it should be feasible to float the minerals with the colloids in the ore. If the presence of colloids in the ore is denied, and a colloid is "absolutely fundamentally" essential, how can we explain the successful flotation of ores by the use of the alkali chlorides?

We are greatly in need of information as to "Why is flotation?" As I mentioned in an article on flotation tribulations³ one should study his problem in the light of the theory applicable, but that in flotation while everybody has satisfactory results, nobody has a satisfactory theory. Ingenious theories have been advanced and upheld with as much dogmatism as Mr. Schwarz holds the colloid theory, nevertheless they have perished. The colloid theory has much merit, but that it is "absolutely fundamentally" so is open to question at this early date. Theories should be accepted in view of the percentage of the total known facts they comprehend, and never in our time as absolute. Centuries of experience have taught us that any prevailing theory is one that merely comprehends more known facts than any other kindred theory.

The importance of research work in colloidal chemistry or in any other line of study is to be emphasized, and was so stated in my article, but qualified in these words, "by those in position to do it." Which again brings up the question of research work with reference to applied metallurgy. If one canvasses the whole world of concentrating mills and cyanide plants, he will find but few laboratories sufficiently well equipped for carrying on the research work that the subject demands. Also he will find very few men sufficiently well prepared for this work who have the time to devote to it. Usually the man detailed to get results, whether manager, superintendent or foreman, has his hands well filled in keeping the plant in operation, in keeping up supplies and labor, and in performing the simple well known tests incident to his process, and has neither equipment nor time for special research work. He even may be reduced to the expedient of carrying out his cyanide tests with beer bottles tied to classifier gears or thrown upon concentrating tables for the necessary agitation, or of making oil stills from odds and ends of sleeves, plugs and re-

¹Technical Paper No. 200 U. S. Bureau of Mines.

²Control of Emulsions in Flotation. M. S. P. Aug. 18, 1917.

³M. S. P. Sept. 16, 1916.

ducers. While excellent results have been obtained in this way, it is inconvenient and a waste of precious time. It is noteworthy, however, that in spite of these limitations nearly all the successful contrivances such as filters, agitators, concentrating tables, furnaces, classifiers, etc., are the result of the patient efforts of those same men characterized by Mr. Schwarz as of "medieval ideas"—the more honor to them! On the other hand, centrally located and privately equipped laboratories or universities with well appointed research laboratories and well stocked reference libraries, and highly trained research men should assume the task of working out the theories and problems necessitating much study and elaborate equipment. That the universities, the United States Bureau of Mines, and the men in the mills co-operating in this work are doing a service of merit is well known, and it is commendable that but very rarely has a member of one branch of the profession had the indiscretion to refer to other members as "ignorant" and "medieval."

JACKSON A. PEARCE.

Berkeley, California.

Analysis of Ferromanganese

To the Editor of Chemical & Metallurgical Engineering

SIR:—I am submitting herewith a scheme for the analysis of ferromanganese, which I have used for some time and find entirely satisfactory. When flasks, pipettes and burettes are properly standardized, I consider the Bismuthate method accurate.

A one-gram sample is dissolved in 50 cc. nitric acid, (sp.gr. 1.13) by boiling gently in a covered beaker for about 30 minutes. Transfer to a liter flask and make up to mark. Pipette out 25 cc. into a 250 cc. Erlenmeyer flask and determine manganese by the Bismuthate method. A N/10 solution of potassium permanganate gives a solution of convenient strength, and a ferrous ammonium sulphate solution of almost equal strength is made by using 39.2 grams of the salt and 50 cc. sulphuric acid made up to one liter.

Dissolve a 0.500-gram sample in a casserole with 50 cc. nitric acid (sp.gr. 1.13), and evaporate to dryness. Ignite over a free flame. Cool, take up in hydrochloric acid, evaporate to dryness again and bake for a few minutes at a low temperature. Take up in dilute hydrochloric acid, bring to boil and filter off siliceous matter. Determine iron from filtrate by titrating with N/10 potassium permanganate solution. Ignite residue, weigh as silica and calculate to silicon. This method is accurate enough for metal low in silicon. For metal containing above 1 per cent of silicon it is recommended that the weighed ignited residue from this or a sodium peroxide fusion be evaporated to dryness with a few drops of sulphuric acid and 4 to 5 cc. hydrofluoric acid, ignited slowly and weighed. The difference in weight multiplied by 0.4702 gives the per cent of silicon.

Treat 1.63 grams as for iron and silicon. After evaporating to dryness with hydrochloric acid, add just enough of the acid to dissolve the residue. Warm and convert into nitrates by adding 20 cc. of nitric acid and evaporating twice down to syrupy consistency. Then add 20 cc. of nitric acid, evaporate to about 12 cc., dilute to about 100 cc. with hot water and allow to cool. When solution is between 65 and 75 deg. C., filter into a 250 cc. Erlenmeyer flask, then add, filtering, 60 cc. of molybdic acid solution. Shake for a few minutes, and set

aside in a warm place for about one hour. Filter on a weighed Gooch crucible, washing with 3 per cent nitric acid solution, dry and weigh. The residue contains 1.63 per cent phosphorus, therefore each milligram found corresponds to 0.001 per cent phosphorus in the metal.

Bilrowe Alloys Co.
Tacoma, Wash.

L. R. TAYLOR.

That Missing Page From the Blue-Back Speller

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read the article under the above title in CHEMICAL & METALLURGICAL ENGINEERING of Dec. 15 and am surprised to learn that any of the steel plants are still using the archaic method of adding lumps of ferromanganese to the steel in the ladle.

I was with the Robert W. Hunt Co. at the time Capt. Hunt started his then novel inspection of rails from the furnace to the loading dock. During this time I was afforded every opportunity for inspecting the open-hearth end of steel-making. It was a part of my duties to follow each heat all through the mill.

Col. W. P. Barba has good grounds for seriously questioning the additions of lump ferromanganese in the ladle. There is no need to go into the rather difficult investigation of how long it takes a piece of ferromanganese of given size to melt in a bath of steel. This would be a somewhat difficult matter to determine. All that is necessary is to take samples from different parts of the heat to which the lump metal has been added. Samples from the first, middle and last ingots should tell the story. I have found that, given a good tap and the ferromanganese added in small pieces just fast enough and not too fast, you may get the manganese distributed and well mixed through the steel. This combination of circumstances is not, however, often realized.

In most cases the ferromanganese is added too rapidly or in case of exceptionally large charges too slowly. In either case the manganese is not distributed evenly through the metal no matter how much current you may get in your ladle. Manganese once thoroughly mixed with the molten steel will not segregate—it must be thoroughly mixed in the first place.

In one plant it was the practice to add ferromanganese in pieces from $\frac{3}{4}$ to 1 inch in the ladle. In the case of this plant I found very considerable variations in manganese content between the first and last ingots poured. Sometimes the first ingot would carry as low as 0.5 per cent manganese and the last 1.5 per cent. The test from the middle of the heat carried around 1 per cent manganese and was apparently all right. In another plant, one with the best of metallurgical practice with this exception, i.e., that about half of the manganese was added in the ladle, I found considerable variations in the manganese content but not as great as in the case mentioned above. The management of the last mentioned plant made a careful investigation of the question and as a result installed an electric furnace so as to melt the ferromanganese and add it in a liquid state as the furnace is being tapped. This practice gives a thorough distribution of the ferromanganese and saves besides about 20 per cent of the manganese, which under the former method was lost in the slag.

Great Falls, Montana.

R. A. DRISCOLL.

Rossiter W. Raymond

DR. ROSSITER WORTHINGTON RAYMOND, mining engineer, editor, author and lawyer, died suddenly of heart failure, on the thirty-first of December at his home in Brooklyn. Dr. Raymond would soon have been an octogenarian, having been born in Cincinnati on April 27, 1840. He spent his childhood at Syracuse, N. Y., and after completing the grammar school grades there, he took a two-year course at the Brooklyn Polytechnic Institute, of which his uncle was president at that time. He was graduated with an excellent record in 1858, and immediately went abroad. While in Europe he attended Heidelberg and Munich Universities and studied mining engineering at the Royal Mining Academy, Freiburg, Saxony.

At the opening of the civil war, he returned immediately to America, enlisted in the Federal Army and served as aide-de-camp, with the rank of captain, on the staff of Maj. Gen. J. C. Fremont, by whom he was officially cited for gallant and meritorious conduct during the strenuous campaign in Virginia which became well known in history, the first time in warfare where underground excavations and mining operations were used in military attacks on fortifications.

Immediately after the close of the war, he returned to New York and engaged in practice as a consulting mining engineer and metallurgist and in 1867 became editor of the *American Journal of Mining*. As his income as editor was not sufficient, Dr. Raymond accepted important additional duties; in 1868 he was appointed United States Commissioner of Mining Statistics, which position he eminently filled, issuing annually for eight years "Reports on the Mineral Resources of the United States West of the Rocky Mountains," and from 1870 to 1882 he taught economic geology at Lafayette College. Dr. Raymond was one of the first to realize the value of professional societies and was not only a charter member of the American Institute of Mining Engineers but devoted the best part of his life to the promotion of its welfare, serving as president in 1872 and 1874; vice-president, 1871, '76, '77 and secretary from 1884 to 1911 and secretary emeritus for the remaining eight years of his life. In 1873, he was appointed United States commissioner to the Vienna International Exposition and during his stay in Europe was invited to address the Iron and Steel Institute at Liege, Belgium.

From 1875 to 1895 Dr. Raymond was consulting engineer with Cooper & Hewitt, proprietors of the New Jersey Steel & Iron Co., the Trenton Iron Co., and numerous iron ore and coal properties. As president of the Alliance Coal Co. and through his association with the coal operators of Pennsylvania, especially with Frank B. Gowan, he became well acquainted with the

facts concerning the memorable campaign against the "Molly Maguires." His activities in regard to labor questions made him known as a courageous and fearless opponent of all tyranny practiced in the name of labor and his articles on "Labor and Law," "Labor and Liberty," etc., published in the *Engineering and Mining Journal* at the time of the Homestead riots attracted world-wide attention.

Dr. Raymond was a deep student of legal matters and was admitted to the bar of the Supreme Court of New York State, and of the Federal District and Circuit Courts in 1898 at the age of fifty-eight. He confined his practice to mining and patent law, in the former of which he was a great authority and on which he gave lectures at Columbia.

As editor of the annual volume of *Transactions* of the American Institute of Mining Engineers, Dr. Raymond reached the highest standard of achievement. He was a master of the English language and had the ability of perfecting the scientific contributions of others so that the words ran fluently, clear, fresh and to the point. He was a constant contributor in the *Engineering and Mining Journal*, where will be found numerous articles both signed and anonymous, which shall always be appreciated for all days to come by the many who have a thirst for information to quench.

In 1884, he prepared for the United States Geological Survey a history on mining law, which was subsequently translated into foreign languages. It is rare that so versatile a person reaches a high degree of excellence in all his endeavor, but it can be easily verified by any of his associates that he did the many things thoroughly. His remarkable personality has become a cherished memory of many members of the Institute and his career a monument among the engineering profession.

Dr. Raymond was an honorary member of the American Philosophical Society, Society of Civil Engineers of France, the Iron and Steel Institute and the Institution of Mining and Metallurgy of Great Britain, and many other technical, scientific and social organizations both at home and abroad. In 1869, shortly before his taking the chair of economic geology at Lafayette, that college conferred upon him the degree of Ph.D. The degree of LL.D. was conferred upon him by Lehigh in 1906 and the University of Pittsburgh in 1915.

In 1911 Dr. Raymond received from Japan the decoration of Chevalier of the Order of the Rising Sun, the highest given to foreigners not of royal blood, in recognition of his advice and assistance to Japanese engineering students in this country.

Dr. Raymond married Sarah Mellen Dwight at Brooklyn on March 3, 1863, by whom he is survived. He is also survived by a daughter, Mrs. H. P. Bellinger, who lives at Syracuse, the childhood home of our beloved engineer, author, editor, lawyer and genius.



ROSSITER W. RAYMOND

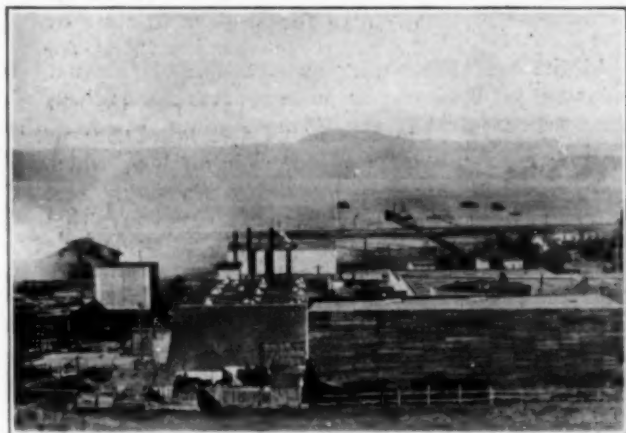
Western Chemical and Metallurgical Field

Recovery of Potash From Molasses Fermentation Liquors

By E. HUMBOLDT

THE PLANT of the Mason By-Products Co., on the north shore of San Francisco Bay, is one of the recent additions to the rapidly growing list of new industries on the Coast. Started last fall to take care of the waste of the distillery of the Mason Malt & Whiskey Distillery Co., it is turning out a large amount of stock feed and crude potash for fertilizers. Later on it is expected to produce ammonium salts, acetates, ether and other solvents, and generally to utilize as far as possible all the contents of distillery waste. The distillery is operated exclusively with molasses, both cane and beet, coming from California and the Hawaiian Islands.

At the present time, owing to poor transportation, it is absolutely impossible to segregate the raw material properly. As most of it is received badly infected with bacterial growths and contaminated with formaldehyde and sulphites, the fermentation is rather difficult



PLANT OF THE MASON BY-PRODUCTS CO.

to control. Lack of time has so far prevented any sterilization of the molasses, but a large sterilizer is being erected, which will take care of all the material used day by day, and it is expected that much better results will be attained as soon as it is put in operation. On this account, the composition of the mash varies enormously and the specific gravity of the waste oscillates between 1.04 and 1.06. Consequently it is impossible to give an analysis representative of its contents. As a rule, by calcination it will yield from 4 to 6 per cent of ash containing 36 to 38 per cent of potash.

For various reasons it has been found convenient to separate the yeast before recovering the potash from the waste or slop. It is settled out, pressed and dried, and sold for chicken and stock feed. It contains from 30 to 40 per cent proteids, figured on dry basis, about 15 to 20 per cent ash, some phosphoric acid and a little potash. Cattle are very fond of and seem to thrive on it, provided it is properly used as part of a well-balanced ration. Experience shows it is particularly well adapted

to the feed of dairy stock, as it increases the milk production. The amount recovered is not large, and the local market will easily handle the whole output. At the present time no effort is being made to recover anything but the potash, and consequently the slop is stored in a battery of six 150,000-gallon tanks (six more are being built), which deliver it as needed to the evaporating furnaces.

The process is very simple, consisting merely of evaporating the liquid as far as possible, generally about 30 deg. B., then burning it in a reverberatory furnace. These furnaces, four in number, are of the Porcion type, but modified to conform to later designs and to obviate many disadvantages of the old type, being easier to clean and of much larger capacity. Each one has three parts, evaporating chamber, calcining pans and a large combustion intermediate chamber. The calcining pans are fitted with oil burners, and the waste heat is used exclusively for the evaporation. The evaporating side is a large shallow pan, made entirely of brick and arched over, in which the slop is fed continuously; a series of revolving paddles keep the liquid in constant motion, producing a heavy spray, which accelerates the evaporation. Owing to the large combustion chamber between the sections of the furnace, the hot gases coming in contact with the evaporating slop are clean and free from soot, and the temperature at the breeching of the stack very seldom rises above 200 deg. C. It is necessary to admit a large excess of air to the burning pans, which must be opened from time to time for stirring and unloading. To secure the proper draft, each furnace is provided with an exhaust pan leading to the stack.

The feed into the evaporating pan is regulated by automatic floats, and but very little attention is required beyond occasional cleaning, charging a liquid of about 7 to 8 deg. B. and delivering it at from 25 to 35 deg. B. The calcining is done by direct flame up to the time when the charge begins to burn, when the fuel is cut down and a large amount of air admitted. With a little stirring to help, the operation is quickly finished, and the black, blazing clinkers are dumped out and wheeled onto a platform, where the combustion completes itself. As soon as the mass is cool enough to handle it is run through a pulverizer and sacked for shipment.

No attempt has been made thus far to leach the clinker to prepare concentrated potassium salts, as the demand for fertilizer material is much larger than the supply and the foreign char and insoluble ash answer filler purposes for this use. The furnaces are provided with fuel meters, recording draft gages and thermometers, and a perfect control and check of their work is at hand at all times. Besides, the whole installation is run by electric power and is very compact and easily handled. Of the four furnaces built, three are in constant use, the fourth being ready for emergency or switched on when one of the others needs cleaning.

The repair work, after four months' operation with unskilled labor, and general upkeep are fairly heavy, as is usual with most new plants. With proper care and supervision, the three running furnaces will take care of about 85,000 to 90,000 gallons of slop daily and can easily handle all the product of the distillery.

Industrial Efforts in France During the War

A View of the Conditions Under Which the Chemical Industry of France Has Developed During the War — Coal Tar Dyestuff, Synthetic Nitrogen, Alsatian Potash, Algerian Phosphate, Soap and Oil Industries Have Great Possibilities

BY GEORGES MAOUSSA*

WHEN, a few weeks ago, I had the honor of being requested by Dr. Baekeland to discuss a subject in which I am so deeply interested, nobody dared to hope that this war would end so soon, and that the problems brought forth by the late events would call for such immediate and earnest attention.

When in 1914 the Germans started this war, they thought of conquering the whole world. Besides other things, this military conquest was to establish, or rather impose definitely, an economic supremacy.

Constant toil and tenacity—we have to acknowledge these qualities of the Germans—and unscrupulous commercial methods had opened to the Germans the markets of the whole world, where they had created for themselves one of the first places. If I recall the agreement for the sale of aniline and, in another instance, the sale of fast dyestuffs in this country, it is needless for me to dwell any further on the importance of the commerce in the hands of the Germans and the moral value of their proceedings.

More than in any other field, the Germans had surpassed other countries in the manufacture of organic chemical products. Thanks to this industry, the Germans maintained for a long time material superiority in practical warfare. For obvious reasons I shall not be able to describe the wonderful progress of chemistry in the field of war necessities. In other branches of chemistry the improvements were not less marvelous, and if Germany hopes to find again a hegemony in that line, she will be bitterly disappointed. Be it in Italy, Japan, England, the United States or France, hidden and even unsuspected energies were awakened. Plants were built, and in four years we made ourselves independent of Germany.

CHEMICAL INDUSTRY TO HAVE HARD BATTLE

During the past years the Germans themselves have been far from inactive, and our young industry shall have to fight a hard battle. A trust including all the German chemical plants awaits but a signal to overflow the world at the lowest price with great quantities of finished products now stored in neutral countries.

With a violent commercial offensive, such as the military one we saw in 1914, they will attempt the destruction of this new industry. Generous support of the consumers and protection by putting high duties on German products will help us to face the first difficulties, but only by selling better and more economical products shall we maintain our position in the long run.

For this purpose an agreement between the producers

is indispensable. We shall have to avoid the scattering of our efforts, the manufacturing of the same products by many people and competition in the world market. First of all, each country should start only the manufacture of products for which its geographical situation, its mining resources and the adaptability of its workmanship make it desirable.

During the war such reasoning could not hold. But now there is going to be a large overproduction of all the war chemicals, the result of which would be, judging from the normal course of events, strong competition and precipitate decline of prices. It is urgent to figure out what we can expect from each country, and what has already been accomplished.

COAL-TAR INDUSTRY

At the eve of the war the situation of the coal-tar industry in France was nothing less than cheerful. How wonderful had been France's contribution at the start of the synthetical dyestuffs industry!

After the discovery of the mauveine by Perkin, the Frenchman Verguin produced fuchsine at Lyons in 1859. Three years later St. Denis, a suburb of Paris, saw for the first time the manufacture of aniline on a large scale by the method of Béchamp. In 1873, the Cachou de Laval inaugurated the series of sulphur dyes and Zacharie Roussin in 1875 was one of the first to make diazo sulphonic acids.

What is left of this promising start? A few small factories operate with small sales, some have disappeared, while others, having kept their French names, are only branches of important German firms.

Under these conditions the private industry was not in the least prepared to meet the enormous requirements of modern warfare. But these difficulties did not dishearten us. Under the presidency of the dean of the French chemists, M. Albin Haller, Member of the Institut, competent chemists assembled at Paris, Lyons and Bordeaux. Manufacturers of Lille and Roubaix, who had seen their factories burned or occupied by the Germans, found credits in banks which up to that time had been hostile to all industrial investments. New plants emerged from the ground as if by miracle.

ESSENTIAL PLANTS MOVED FROM WAR ZONE

One of the electrolytic chlorine plants worked till practically under German shellfire, until the situation became unbearable. The High Command sent a company of engineers who moved cells, engines and boilers and a few weeks later a fine chlorine plant had arisen way down south on the banks of the Rhone.

An oil of vitriol plant was on the firing line. The first and second line trenches went through the build-

*Lecture delivered at the Société de Chimie Industrielle, New York, Nov. 19, 1918.

ings. If the least bit of smoke had come from the stacks, German shells would soon have destroyed buildings and equipment. We were in great need of sulphuric acid. In the dark of the night pine trees were brought down from the Vosges mountains and put into the building to support the roof. Then the plant was dismantled. On moonless nights long lines of trucks took pipes, furnaces, engines and the whole equipment to the rear and when finally the enemy discovered that something abnormal was going on in the plant, their shells crashing through the roof hit nothing but the few dried out pine trees. Some time later this same plant produced in another part of France 15 tons of acid daily.

MANY PLANTS CONVERTED TO MUNITION WORK

In the heart of France a peaceful looking flour mill, situated on the idyllic banks of a rivulet, astonished the villagers one day by the strange sight of columns of red smoke escaping through the roof. A new nitration plant had been started.

Elsewhere a mineral oil distillation plant was transformed into a nitration plant. But the people interested there were not satisfied with following the ordinary methods. In my opinion, they built the finest nitration plant in the world. No fumes, no smells, none of the precious liquid lost through leaking pipes or connections. The whole process is performed automatically. On one side the hydrocarbons and the acids flow in a continuous stream into the apparatus and without any human guidance run out on the other side a finished product, ready for packing. Only one attendant is present, who looks after the oiling of the machinery.

Not only was there a shortage of the chemicals, but also of men, equipment, steel, iron and foundries. Often we had to make use of rudimentary reactions on account of the scarcity of apparatus we had at our disposal.

Chlorine, which so quickly became an important factor in warfare, was not available, and the same was true of electrolysis plants and manganese salts to produce it.

Though an early end of the war was predicted about every six months, the execution of a far-reaching program was started. It comprised some factories which are going to continue their production in the future.

Before the war the output of the French coal mines was 40 million tons a year; 20 more millions had to be imported. Of that whole production seven-tenths originated from the mines of northern France—a part of which was at the very beginning of the conflict invaded by the Huns. The same happened to the iron industry, of which 87 out of 117 blast-furnaces fell into the hands of the enemy.

PRODUCTION OF TOLUOL AND BENZOL

The most up-to-date coke plants were situated in these same regions—at Lens, Liévin, Douai—and their loss was a heavy blow to France. Before 1914 the importation in France of coke byproducts amounted to 80,000 tons and the French output of benzol was 10,000 tons.

It was impossible to increase the production of benzol to such an extent as to meet fully the requirements of the powder plants. New coke ovens were built in the coal region of the St. Etienne; others, working with imported coal, at St. Nazaire for instance, improved their

yields of the by-products. The gas plants at Paris, Lyons, Marseilles, Bordeaux and Nantes undertook the washing of gas to extract toluol and benzol, by means of which about 6000 tons of benzol and 2000 tons of toluol were obtained. But as these quantities did not suffice, importations had to make up the balance.

In the line of inorganic products the situation was different. We held the second place for the production of sulphuric acid and phosphates. For instance France's contribution was of 1,000,000 tons of chamber acid. The manufacture of fertilizers, which absorbed 75 per cent of that acid, was stopped and the acid turned over to the munition plants. But this amount was far from sufficient. The St. Gobain Cie., whose largest plant was in territory occupied by the Germans, doubled the size of all its other plants which are located in other parts of France. The Société Kullman of Lille built at Port de Bouc, near the mouth of the Rhone, an entire town, with docks, piers and railroad connections, and erected a lead chamber acid works. Other plants grew up on the Atlantic coast at La Rochelle, St. Nazaire, some of these having a capacity of 200 tons of 66-deg. Baumé acid a day. Last year the total output reached more than 2,000,000 tons of 50-deg. acid.

On the other hand there were but few oil of vitriol factories, to supply which a large number of contact plants were installed. Correct statements of their production has never been published. Thanks to a tremendous increase, importations of sulphuric acid could in 1916 be limited to 100,000 tons.

MANUFACTURE OF NITRIC ACID

In 1913 France imported 320,000 tons of sodium nitrate from Chile, 90 per cent of which was used in fertilizer. Nitric acid was produced on a small scale, and to get the required equipment a stoneware industry had to be created. Up to that day the Manufacture Nationale de Sèvres had produced only artistic porcelains. In a short time they were able to turn out any type of stoneware used in the Valentiners, or for picric acid. Besides, the town of Grenoble has become a center for the making of acid proof metals. From 15,000 tons in 1913, the manufacture of nitric acid went up to 600,000 tons in 1916, and the importation of nitre reached 540,000 tons.

The question of fixation of nitrogen was not as vital as in Germany, but nevertheless attention was paid to it. The first plant was built at La Roche de Ham, in the Pyrénées Mountains, and worked on the principle used in Norway. At Briançon, 7500 tons of cyanamide were made; there, the water power was increased and now 200,000 hp. is available, which will give 100,000 tons of cyanamide a year. Other research work has been made in this line, but no results have been published.

As was the case with nitric acid, the lack of chlorine was a serious problem at the beginning of the war. Several plants working with manganese salts had to be shut down on account of the impossibility of getting raw materials. Other plants were started using chlorate of sodium as an oxidizer. The output of chlorate of sodium was so large that we were able in 1915 to provide our allies with 10,000 tons of it, a marvelous increase over the 1000 tons of 1913. Before the war France did not produce any liquid chlorine. About 20,000 tons a year

are being made at present. At the same time, the production of bromine had developed in France and 500 tons is the yearly output.

In 1913 France had an excess amount of 15,000 tons of caustic soda, which she exported. Now things had changed, this quite respectable production, increased by the new electrolytic chlorine plants, was not sufficient, and she had to import caustic.

Such a large amount of raw materials being now available, the production of war necessities took enormous proportions, and in the hands of our brave soldiers these powerful weapons brought in 1916 and 1917 German militarism to the verge of disaster.

In the region of the Alps a single plant turns out 160 tons of phenol a day and in France in 1916 the production of explosives, not including smokeless powder, was 600 tons a day and reached soon after 800 tons and even 1000 tons a day.

THE DYESTUFF INDUSTRY

At first the French army wore red trousers. Experiments had been made on cloth of dull shade, but when trials were made to apply them it was impossible to get the dyestuffs. The imported tinctorial extracts determined the horizon blue, the color which was adopted for the continental troops. For the colonial army every shade and kind of khaki had to be used.

At the same time the Government started the making of indigo, and as nowadays a perfect method for the manufacture of monochloroacetic acid has been found, nearly all the cloth for the army is dyed with indigo. Besides the Government producing indigo, other plants started the manufacture of dyes. In spite of the scarcity of raw material and coal, and especially of apparatus and machinery, the monthly production amounted in 1917 to approximately 250 tons and is now about 400 tons. Two-fifths of these dyestuffs were black.

Among the fifty-odd different shades manufactured in appreciable quantities, a great part are sulphur dyes, but also diazo, basic and fast dyes are now on hand. For the purpose of amalgamating these different efforts and giving them new strength, the Cie. Nationale des Matières Colorantes, under the protection of the French Government, has been founded. This concern has at the present time an entirely paid up capital of 71 million francs. The present complications and difficulties have not prevented the company from undertaking and starting the manufacture of indigo, alizarine and different other anthracene dyes. In accordance with the French character, which endeavors to obtain first of all products of quality, particular attention is given to the manufacture of fast dyes.

The dyestuff industry, being the cornerstone of every other synthetic organic industry, has been backed up to a certain extent and will have to be maintained for a while after the war. Other factories could only continue the production of munitions. For instance, the wood distillation output was increased. Hexamethylene tetramine, which up to the present time had been exclusively an imported article, was manufactured at a plant near Nevers. On the banks of the Rhone another factory was founded for the production of formic and oxalic acid, and in the same part of France aspirin and saccharine were made, restrictions having been strongly modified on the latter product.

AGRICULTURAL PRODUCTS INDUSTRY SUFFERS DRAWBACK

The industry of products connected with agriculture was very prosperous, but suffered a drawback during the war. Let us hope that its importance will soon be regained. Marseilles has two great advantages—first, it is a gate to Africa and the Orient and, second, it is the terminal point of the Rhone valley, which has become of such inestimable value in the chemical industry. The pre-war total production of oils at Marseilles alone was 1000 tons per day and her exportation in soaps was 45,000 tons a year.

The situation at Bordeaux is favorable for the trade with Africa, especially Morocco. This country being unusually rich in wheat and oils, Bordeaux is preparing facilities for the handling of these products and a 300 tons of flour per day mill is operating there.

The supply of tinctorial and tanning extracts was sufficient to permit exportations on a large scale as shown by the statistics of 1913; which is 15,000 tons quebracho and 120,000 tons of chestnut extract. But the appetite of the great war machine was not yet satisfied, and again we see the tireless hands and brains of research chemists working on a new process for synthetic tanning material and the result of their effort is a new industry at Lyons.

Without going into any details, I would like to call your attention to the distillation of rosins, centered at Bordeaux; 10,000 tons of the best turpentine are worth while mentioning.

Neither must I forget to say a word about the industry of essential oils. The sunny climate of the blue shores of the Mediterranean is ideal for the growth of flowers; 5,000,000 lb. of rose leaves, 3,000,000 lb. of jasmine, 1,000,000 lb. of violets and more than half a million pounds of tuberose—that is what the fragrant crop amounted to. And the fair sex of the whole world adds to its charms by using 30 million francs' worth of the precious essences distilled from these flowers.

The overproduction in inorganics may only be apparent. Are not the needs of the soil now greater than ever? Impoverished by four years of insufficient care, we have to make up for this neglect with great quantities of fertilizers. Ours is the wealth in phosphates of Algeria and Tunisia; so are now the potash mines of rewon Alsace, and with these raw materials we shall eat up the 2,000,000 tons sulphuric acid and supply the exhausted countries with fertilizers.

Up to the present time all our efforts tended to destruction. Now the same means which made our war machine so disastrous to the enemy are going to be sources of blessing and wealth to the country.

Phosphorus in Copper Alloys

One grain of low phosphorus alloy and 0.25 gram of high phosphorus alloy such as phosphor copper is, dissolved in a mixture of 75 cc. HNO_3 , 1.13 sp.gr., and 3-5 cc. conc. HCl . After solution is complete oxidize both HCl and phosphorus by adding KMnO_4 , 2 or 3 cc. at a time, until MnO_2 separates out. About 15 cc. will be necessary. Do not allow solution to boil down. Reduce MnO_2 by oxalic acid, leaving clear solution, add 10 cc. NH_4OH and 50 cc. molybdate solution. Filter off yellow precipitate and titrate with NaOH and HNO_3 .

Notes on Electrical Precipitators

A Summary of Observations Taken From Several Installations — Scope of Process Expanding — Power Consumption, Voltage, Velocity and Temperature of Gases Must Be Experimentally Determined — Types of Rectifiers, Electrodes and Insulators

BY ERNEST EDGAR THUM

COTTRELL'S electrical process for precipitating suspended solid particles, condensed fume or vapor from a gas stream is relatively familiar to most readers. It depends upon the fact that when such a gas is passed slowly through an electrical field set up between oppositely charged electrodes the gaseous molecules become ionized and the solid or liquid molecular aggregates acquire an electric charge and receive a directional impulse depending upon the potential gradient of the surrounding field. Thus a small current of electricity passes from electrode to electrode by conductance of the ionized gas and transport of the charged particles. In practice the field is maintained by high-voltage unidirectional current, the negative electrodes consisting of a series of small wires, chains, rods or pipes placed axially in pipes or between parallel metal plates. These pipes or plates are grounded electrodes to which the charged particles largely migrate, and may therefore be called "collecting electrodes." Flues for handling the dirty and clean gas and hoppers for temporarily storing the accumulating precipitate complete the essentials, except for the special electrical equipment for current production and delivery.

The Cottrell process has been a godsend to more industries than to metallurgical plants alone. Early developed as a method to mitigate nuisances and damaging fumes, it was soon found that the deposits had considerable value as by-products.

GREATER SPHERE OF USEFULNESS

The latest installations as an integral part of manufacturing processes point the way for an even greater sphere of application and usefulness. It is only natural then that the application of even such a relatively simple physical principle to so widely different problems should lead to numberless differences in detail. Indeed, success depends upon many different conditions, and a large number of installations are preceded by painstaking experiments to determine the best way to clear the gases of their impurities. It is extremely difficult to predict the power consumption, voltage, velocity and temperature for correct operation until actual preliminary experimentation has been completed on the gas. The general success of the process is testimony to the excellence of these investigations, as well as to the bulldog grit and determination of the operator, since the latter often encounters most baffling vexations which he is prone to ascribe to the design of his plant. As in all cases, the builder should give much attention to the needs of the men who must make the machine run, and it is hoped that these notes, which apply mostly to the larger installations occurring at smelting plants, may be useful in fixing attention on some important problems confronting designer and operator.

The power house should preferably be quite close alongside the treater, with switchboard and windows so arranged that the electrician can at all times have a clear view of his assistant who operates the knocking mechanism and watches the clearance being effected. The operating platform should be strongly and thoroughly illuminated so that mutual signals may not be interrupted by darkness or foggy weather. Should such a layout be impossible for valid reasons, intercommunication can satisfactorily be maintained only by telephone—receptacles should be installed at a number of points, readily reached by short lines from operator's head-sets. By means of call bells the two partners may thus get into intimate contact without delay. As a safety-first precaution in any case, interlocked colored lights on the circuit-opening switch at each unit should indicate whether the high tension current on the treater is on or off.

It should be borne in mind that the operation of the treater plant will be largely adjusted by the appearance of the exit gases. Indeed, in many cases an excellent recovery of values is effected although the visual clearance is poor; thus a fair visual clearance indicates a satisfactory recovery. Therefore the method is not only simple but effective. In a large installation, one man will continuously be watching the condition of the gases issuing from the treater tubes. Proper illumination should be provided so as to permit easy observation through openings glazed with acid-resistant panes, the illumination extending to all portions of the treater's interior. Observation of the gas as it issues from the tubes is most essential when the effluent is mixed with other smoke before being discharged from the chimney, or when handling hot humid gases which condense a cloud of water particles immediately upon mixing with the colder outside air. Watching the smoke from such chimneys evidently is of limited value. In all cases a series of properly made filtration tests is the last resort to determine the actual efficiency of the electrical precipitator.

For the protection of both the man and the treater the plant should be adequately roofed—if conditions are such that a certain temperature of gas in the treater must be exceeded, as discussed later, it may even be necessary to house it completely during the winter. Conditions which make for the comfort of the operators will in nearly every case inure to the benefit of the plant operations. Thus, in case the draft conditions are such as to require the use of a fan it should generally be placed beyond the treater so that the latter will operate as a "suction" chamber rather than a "pressure" chamber. Should the pressure inside a treater be greater than atmospheric, fume and smoke may blow out through the seams and openings—an ab-

olutely gas-tight job would then be required. Again, after shutting off the gas previous to repairing a treater section, the atmosphere in a suction chamber may be cleared in a few minutes, much more rapidly than if it were under pressure.

POWER EQUIPMENT

The advantages of sectionalizing a large treater plant are obvious. The same is true of the power house. If each section of the treater is connected to its individual electrical supply, that is, if there is a complete set of motors, transformers, rectifiers, voltage regulators and miscellaneous switchboard accessories to correspond to each division of the precipitation plant, it will be possible to operate each section independently of its neighbors and the electrical conditions in it can be adjusted to secure the best results.

Without attempting a discussion of the special electrical machinery which has provided rugged transformers, low speed alternators, rectifiers and special

out may produce a poorer wave-form and more oscillations building up dangerous electromotive forces than a larger machine in the first system, and thus show to poorer advantage. On the other hand in units of large capacity, operating troubles in one section may modify the current delivered to all others from the central generator, so that the latter scheme would then be more satisfactory.

While the first-mentioned power plant is somewhat simpler, it can be installed but little more cheaply than the second when proper induction voltage regulators are included. At most, the electrical equipment costs but 15 per cent of the total, and it is false economy to install unsuitable machinery, since in this case the yearly repairs and renewals may mount to one-quarter the first cost, and unsatisfactory operation cause the whole to be discarded after a short life. Operation demonstrates that precipitating conditions in each treater-unit may vary so much as to require individual electrical control—indeed, ideal conditions are reached when the voltage existing on each discharge electrode can be adjusted.

Spare armatures, of course, will be provided; but a spare transformer is often neglected, although it is nearly as essential. Horn gaps may be used to assist in protecting the transformer insulation, set slightly further apart than the radius of the treater pipes. Ample precautions should be taken to protect all transformers, rectifiers and other equipment. Permanent series resistances in both high and low tension lines are effective in interrupting oscillating discharges and limiting short circuits. Condensers shunted across the generator leads are also useful in absorbing surges reflected from the transformer windings. Adequate lighting and switchboard protection will be suggested by the electrical designer as a matter of course.

It is well to have all the electrical machinery of large capacity. In this relation, the preliminary investigations should determine particularly the electrical characteristics of the precipitated material, since it has been shown that the resistance of the gap between clean

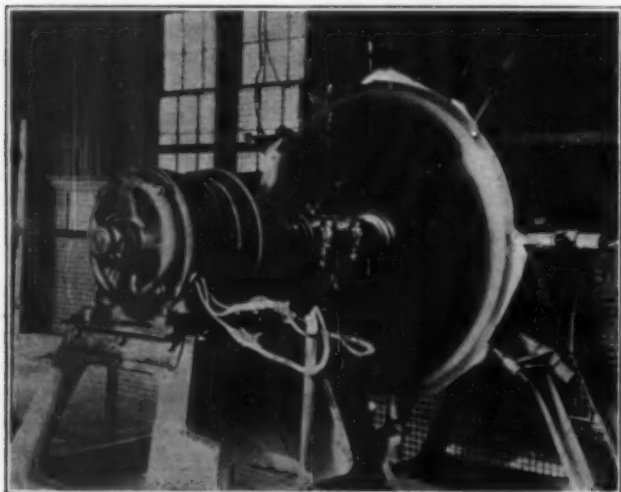


FIG. 1. MECHANICAL RECTIFIER DRIVEN BY SYNCHRONOUS MOTOR

high-tension voltage regulators, it may be said that two methods of current production are in vogue: First, a large alternating current generator of proper rating and design may furnish enough energy for the whole plant, but each treater section will have a separate transformer and its own rectifier driven by a quite small synchronous motor, as shown in Fig. 1. Included in this classification is the case where an industrial circuit of large capacity supplies the transformer-rectifier-treater units. The alternative power house layout shown in Fig. 2 requires a motor, generator and rectifier all on one shaft, the alternating current necessary for the treater unit being generated, transformed and rectified entirely independently of any other unit.

Which of these systems is best is a matter for careful consideration—no dictum should be laid down, since doubtless each has its sphere. Experiments at Anaconda indicate that the wave-form has a determining effect upon the efficiency of the precipitation. Such being the case, commercial current whose characteristics may be suddenly distorted by outside loads should not be rectified. However, this current can be used to drive a single-phase generator especially designed to produce the correct wave-form. Thus it may be that a small motor-generator set working in the second lay-

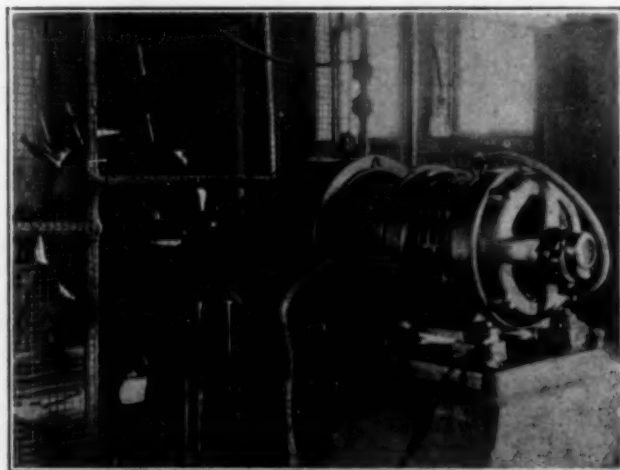


FIG. 2. MOTOR DRIVING A SINGLE-PHASE GENERATOR AND MECHANICAL RECTIFIER

discharging and collecting electrodes may be lowered as much as 50 per cent by a thin non-conducting deposit. The voltage on the system must then be lowered in order that heavy arcs may not trip the circuit breakers. Such discontinuous dielectrics retain their electrical charges

and ionize the surrounding gases if the dielectric constant of the particles be large. The remedy is to make the deposit conductive by humidifying the gas or (in case corrosion is feared) by adding a conducting dust like carbon.

Obviously large voltage regulation may best be had by changing the tap into the low-tension side of the transformer, and close regulation within these steps by adjusting the voltage produced by the alternating current generator. The wave form of the rectified current and to a less extent its voltage is adjusted by rotating the rectifier "brushes" slightly.

CURRENT CHARACTERISTICS

In order that this may be clear to those who are not well acquainted with such installations, it may be well to diagram an early rectifier quite good for low voltages. This consists of two conducting arms set at 90 deg., insulated from each other and the shaft which drives them. The brushes (which are merely short lengths of trolley wire suitably held in insulated clamps with ends about $\frac{1}{4}$ inch from the edges of the rotating segments) are also at quadrant points, and are connected as shown in Fig. 3. At the instant sketched the transformer may be assumed to be giving its maximum negative potential to *b* and *c*, while *z* and *w* are correspondingly positively electrified. The positive electricity jumps the short air gap at *w*, travels through arm *v*, across the gap *y* and thence to earth. Similarly a negative current is delivered through brush *b*, arm *a*, brush *d*, and line to the wire electrode. In the treater itself the circuit is completed from charged wire to grounded pipe through the ionized gas.

Fig. 4 is a sketch and Fig. 5 a photograph of the rectifier now commonly used. It consists of a synchronously rotating disk of non-conducting fiber or composition to the edge of which is riveted the metallic

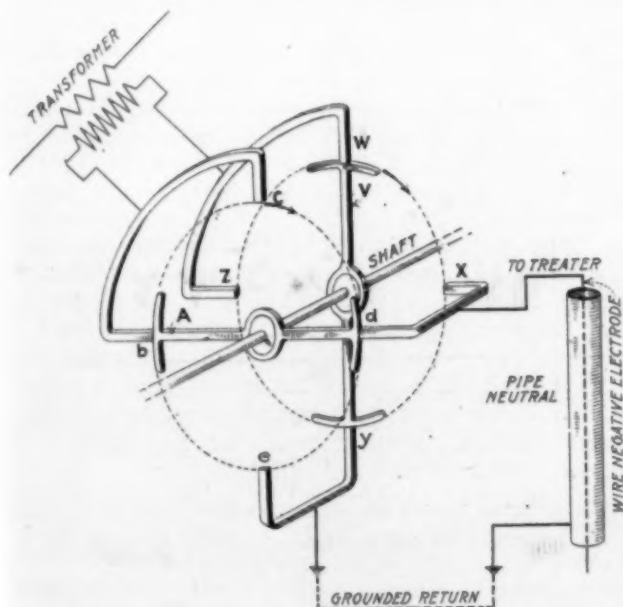


FIG. 3. EARLY RECTIFIER FOR LOW VOLTAGES

quadrants A and V. Brushes *b*, *d*, *y* and *z* are metallic horns symmetrically fixed in a movable frame. Its operation is quite similar to the older style, and can be easily traced in the light of the following discussion.

Referring again to Fig. 3, the rotation of the arms A and V interrupts the circuit when the moving end of the segment draws the arc out to a breaking point; meantime the voltage delivered by the transformer is decreasing and by the time the shaft has rotated a quarter-turn the current has reached its opposite maximum. Arm A will then be opposite brush *c*, delivering its charge (then positive) to ground through *e*, while arm V will deliver another negative impulse from brush *z* to the treater through brush *x*.

In this manner unidirectional, intermittent current is sent to the wire electrodes in the precipitation plant. Reference to Fig. 6 will give the characteristics of the current sent to the treater, where the wave is the

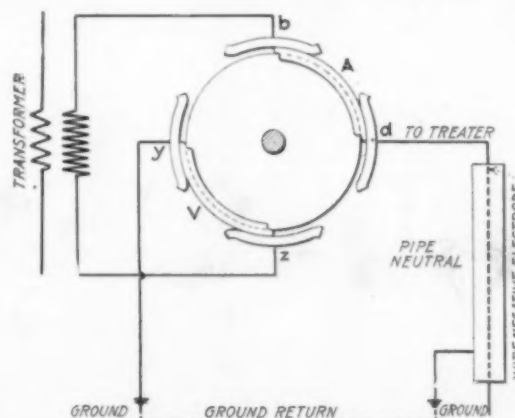


FIG. 4. WIRING DIAGRAM FOR MECHANICAL RECTIFIER FOR HIGH VOLTAGES

ordinary sine curve representing the time-voltage relations of an ideal alternating current. Arm A collects the troughs of the waves during a time on each side of the minima shown by dark portions of the curve, while the peaks are collected a half-period later by arm V. If all eight brushes are attached to a frame capable of being rotated around the shaft, it is easily seen that turning this frame counter-clockwise will collect the current at an earlier time on the increasing voltage wave. Fig. 7 shows the portion collected in darkened lines as before, and it is plain that each impulse starts at a relatively low voltage, rapidly increasing to the maximum, when it is interrupted. On the other hand, clockwise rotation will first catch the current nearer its crest voltage and deliver an impulse of rapidly decreasing potential (see Fig. 8).

In adjusting the treater clearance it is common for the electrician to throw the brush holder to one limit of its travel, and then move it slowly back and forth until his assistant watching the clearance signals the best location. Then the appearance of the arcing of the rectifier or the reading of a milliammeter on the high tension line is relied upon to exhibit variation in electrical conditions in the treater. Naturally "fine-haired" adjustment of these brushes is not essential, since changing conditions in the treaters demand attention from the operatives at intervals. Synchronism between the alternating current and rectifier is of prime importance, however—this synchronism is evidently absolute when generator and rectifier are keyed to the same shaft.

Since the part of the current wave propelled toward the treater depends upon the potential of the crest, the

width of the air gap and the length of the brushes (as well as the angular setting of the latter), it is evident that the adjustment of the position of brushes such as sketched in Fig. 4 will greatly alter the characteristics of the sparking at the rectifier. The peak only may be collected, resulting in short snappy arcs at the rectifier, or long flaming arcs may almost envelop the circumference of the disk when commutating long portions of

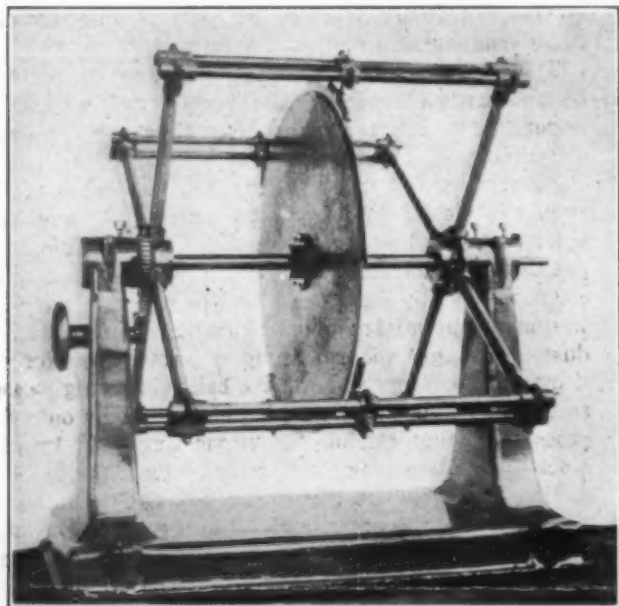


FIG. 5. MODERN RECTIFIER

the wave. The latter obviously transmits a greater amount of energy into the treater.

Constant tampering with the brushes is not conducive to best operation, for if other things are equal the efficiency of precipitation will vary as the impressed voltage. It is therefore essential that the power house deliver uniformly a potential closely approximating that which produces arcing in the treater tubes. The potential wave actually existing across the electrodes is very flat, quite different from that existing at the brushes, since the treater acts like a condenser, and discharges very slowly by transport of charged particles.

ELECTRODES AND INSULATORS

Treater construction has been standardized to the extent that the smelter smoke to be cleaned usually flows from a hopper to a collecting flue through upright pipes or between parallel sheets. This whole structure is grounded. The negative current is distributed to wires, chains or thin pipes, stretched by weights or springs through these collectors and accurately centered at both ends by latticed frames. These frames in turn are supported by cross-beams extending through openings in the hopper and flue walls, there resting on proper insulators and protected from accidental contact by a basket or "pent-house." However, it is not desirable to depend upon air seepage to keep the dust from gradually settling on the insulator, especially in case the gas carries free sulphuric acid (as do copper converter and roaster gases).

In the latter case a treater designed to catch dry dust must operate at a temperature above that of any considerable condensation of the free acid, and any

infiltrating cold air would speedily deposit a tenacious acidic film upon the insulator, causing grounds and punctured insulator petticoats. In such cases it has been found desirable to frame a beam into the ends of those supporting the latticed frames, which beam will extend longitudinally outside the flue walls. This longitudinal beam is then supported by insulators placed centrally some distance from the openings. The whole is enclosed by an iron box, preferably welded air tight at all joints, with weather-stripped doors of glass opposite each insulator, all as shown in sectional plan in Fig. 9. An excellent precaution is to have the levers controlling the high tension tower switch so arranged as to extend in front of these doors when the current is on. In order to get into the insulator box it is then necessary for the attendant to move the switch levers, thus cutting off the current before being able to open the door.

REPLACING PUNCTURED INSULATORS

A large item of upkeep is for replacing punctured insulators, so that careful testing is necessary to get a suitable type. Often it may prove that an inexpensive insulator lasting but a relatively short time will be more economical than a costly one of little longer life. Satisfactory home made insulators are in use on moderate voltages consisting merely of a pile of porcelain slabs, about $\frac{3}{4}$ inch thick and 6 inches square, alternating with acid-proof tile, of the same thickness and about $3\frac{1}{2}$

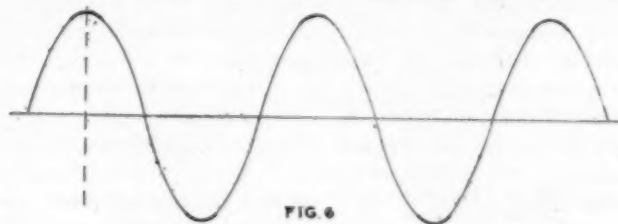


FIG. 6

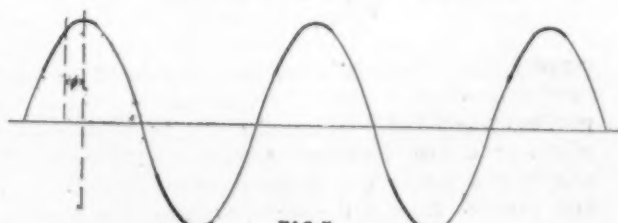


FIG. 7

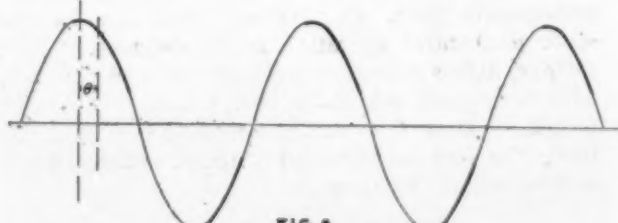


FIG. 8

FIGS. 6 TO 8

Fig. 6. When brushes are set at theoretical point of maximum voltage.

Fig. 7. When brushes are rotated counter-clockwise through an angle θ .

Fig. 8. When brushes are rotated clockwise through an angle θ from theoretical position.

inches square. It is hoped that research now under way may develop a new type of insulator which will stand up in warm, dusty and acid-laden atmospheres.

The collecting tubes or plates of course should be quite clean and smooth so that no electrical leakage at shortened air gaps may occur. In some installations cor-

rugated iron has been found to be a good material with which to build collecting plates. In tube treaters, it would evidently be good policy to expand the ends of the tube into a pronounced bell before joining into the top and bottom sheets to reduce electrical leakage at the ends.

However, as precipitation proceeds a fume deposit builds up on both pipe and wire, facilitating point-discharges and decreasing the air gap as well. In order to restore the tubes to their normal condition it is necessary to shake this dust free at intervals. Mechanical rapping may be done by hammers hung from an oscillating horizontal shaft between alternate rows of pipes striking on welded pads, and a similar hammer striking compression springs fixed on the latticed frames supporting the electrodes. The current of electricity must evidently be interrupted during shaking of the charged electrodes and is usually stopped when

near its capacity, shutting the gas from the unit being shaken will only overload the others, and some loss in clearance and values will ensue. In such cases it would probably be well to rap the plates or tubes at short intervals without interrupting the gas or current, cutting off the electricity only when rapping the charged electrodes at longer intervals. In the case of inflammable or explosive fume it is essential that the treater be large enough that both the gas and electricity may be interrupted during shaking, so sparking may not cause disastrous fires.

The snapping discharge of spark-overs can be heard by the treater tender or located by looking into the upper flue or lower hopper. If a thorough rapping of electrodes will not stop the trouble or if a localized arcing discharge is robbing the bulk of the tubes of their supply of electricity, it may be necessary to shut down the section, and remove the cause. Should this be the presence of dust accumulations, it will be necessary to clean thoroughly each tube by raising and lowering a weighted, special boiler-tube cleaner. Fortunately the dust is strongly adherent only in rare cases—for such it may be necessary to build the balloon flue high enough so that the weighted electrodes may be taken out of the pipes by bodily raising the supporting grid by chain blocks, when a scale-cutter operated by a motor driven flexible shaft can be thrust through each pipe in succession. Such heroic and disagreeable alternatives might be obviated by changing the characteristics of the deposit by proper additions to the entering smoke.

After the electrodes are properly cleaned, centered and weighted, operations should approach normal. Snappy spark-overs do not affect the treater operation seriously, since they consume but little power, and the generating system and transformer are protected from the effect of the momentary short circuit by the rectifier. As is seen from an examination of Figs. 6, 7 and 8, at each half-cycle there is a complete separation between the alternating current supplied to the rectifier and the unidirectional current delivered by it. For 60-cycle current most of these line disturbances are therefore cleared in much less than 1/120 part of a second. Localized arcing is more rare, and is instantly recognized by a jumping ammeter needle and heavy flames at the rectifier. Such arcs should open circuit breakers before damage is done, or can be made to introduce a protective resistance in the low-tension circuit automatically.

Fortunately wire electrodes are seldom burned off or fused, owing to the relatively low amperage of the spark-overs. Considerable difficulty has been experienced, however, in a case where the weighted electrode wires were centered by small holes through the lower grid. Variable resistances at the top caused considerable current to be fed through the bottom spacer—this recurring and localized spark burned off many wires, dropping the weights and shutting down the unit. This trouble has caused the adoption of springs for giving the required tension, but their failure through rapid annealing at elevated temperatures suggests that a more rational solution would have been to have the lower grids carry stirrups which would center a sash-weight of such considerable diameter that its fusion would be impossible.

A thin non-conducting deposit, a thick conducting

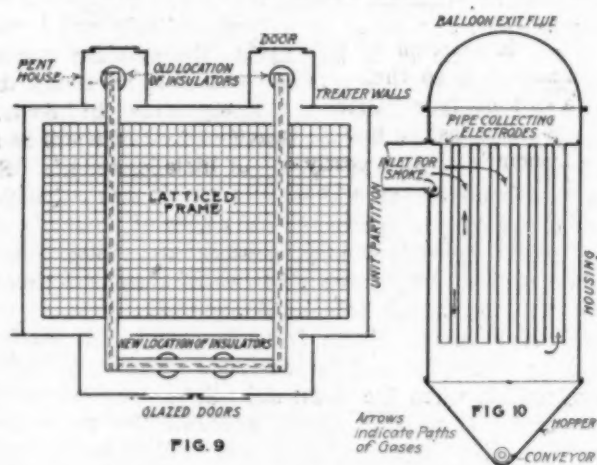


FIG. 9. METHOD OF PLACING INSULATORS DISTANT FROM OPENINGS INTO BODY OF TREATER. FIG. 10. SKETCH OF TOP INLET FOR UNIFORM GAS DISTRIBUTION

rapping the collecting electrodes, but in any case the jarring mechanism should be grounded in two independent ways. In passing, it might be stated that the whole grounded structure should be connected thoroughly and carefully to a return wire. A little trouble and expense here will save foundation piers split by corroding anchor bolts, electrolysis of water mains, and perhaps life itself. All rapping is best done by power, since mechanical operation is independent of human fatigue, and is therefore more efficient and expeditious. The equipment, especially ball cranks and bearings, should be more than amply strong to endure satisfactorily the severe alternating stresses without frequent and vexatious breakages.

INTERRUPTION OF GAS CURRENT

Whether the gas current should be interrupted during shaking depends largely upon conditions. In large sectionalized installations the provision of one complete unit in precipitator and power plant is desirable. With such a layout one unit may be regarded as a spare and may be continually out of service for cleaning or for repair of any integral part without interfering with the proper operation of the plant. With all units operating, an ample margin for good performance is furnished. If, however, the entire treater plant is working

deposit or a derangement of electrode spacing may reduce the treater voltage, as already noted. In addition to this, leakage over wet or defective insulators may be very hard to locate and cause serious trouble. Again, at more than 50,000 volts stretched wire electrodes tend to vibrate in elliptical orbits on account of unbalanced attractive forces being suddenly relieved by a local arcing discharge. (Damping rods or the use of chain electrodes cures this tendency—very high voltages may require rigid electrodes.) A further cause of lowered voltage is the screening of the discharge due to a high concentration of dust or fume in the gas. Should the polarity of the charged electrodes become reversed through any cause, a corona discharge will occur at a fraction of the negative potential.

Since the efficiency of the precipitation depends upon the maintenance of the maximum voltage in the treater, constant attention to all such points is required of the careful operator.

GAS DISTRIBUTION AND TEMPERATURES

Properly made experiments preliminary to construction will determine the best conditions of voltage, pipe lengths and diameter for all normal variations in temperature, composition and velocity of the gases. It is not so easy to translate the results attained with one or a few pipes to an installation containing hundreds. Perhaps the most trying thing is the attempt to insure equal gas distribution to all of the dozens of pipes in one section, especially with the low velocities desirable.

If the main intake is merely a pipe opening into the side of the dust collecting hopper, it is evident that there may be large differences in pressure in the collectors with their varying distances from the intake. In some cases the gases are discharged through a ventilator-like hood set in the center of the hopper. Then the corner and middle pipes may suffer. The difficulty of operating a rotating gas distributor in a dust-laden, acid atmosphere can well be imagined. The design should be such as to prevent eddies as far as possible. Evidently nearly ideal gas distribution could be provided in a vertical-pipe treater if set directly above a furnace outlet, connection between the two being made by a straight, uniformly tapering flue. Or, in their passage through a long, straight flue of ordinary construction, if the gases should pass through a section containing vertical sheets and horizontal electrodes placed parallel to the flue walls, they would suffer the minimum derangement in pressure, direction and velocity while going through these narrow passages.

Many peculiar installations may be ascribed to the fact that the precipitator was added to an operating plant where scant opportunity for a correct layout existed. Where head-room is lacking or a tall structure seems undesirable, a distribution as good as any attainable after a sharp turn may be had by introducing the gas near the top of the housing around the collecting electrodes, as sketched in Fig. 10.

Even with the most perfect mechanical design, however, furnace operations vary enough to make large differences in temperature, volume and composition of the gas to be handled. If differential precipitation is to be attempted, close temperature control will be essential so that only the desired volatiles may be condensed. In this case, the treater pipes may be surrounded with

adjustable louvers, so that cold air can be excluded or admitted, as the case may be. At the other extreme, it may be necessary to keep up the temperature of the entering gases by previous admixture of hot furnace gases from another source. Fume-laden gases are often cooled, and at the same time their electrical conductivity and efficiency of the precipitation bettered, by water sprays discharging into the flue leading to the precipitating plant. This last method must be used with circumspection, however, if acids are liable to be formed and collected in the precipitator.

Large temperature variations have another profound effect on treater operation besides the fact that a rise in temperature lowers the arcing voltage, which is that it causes large differences in the volume of gas to be treated, and consequently its velocity through the treater. A particle of fume starting up the precipitator wanders about in an indefinite manner until it acquires an electrical charge, when it is impelled to one electrode or the other at a comparatively rapid rate. If the particle is to be caught, the original vertical velocity must not carry it out of the electrical field before it becomes electrified. Recognizing this fact, a careful designer would be justified in adding perhaps 20 per cent to the pipe length which experiments show to be about right, to take care of the unusual velocities which are sure to appear.

Certain operations may produce a fiendish smoke which will not only corrode the metal about the treater but will also precipitate an inflammable (not to say explosive) fume. Fume from Dwight-Lloyd roasters making sinter for lead furnaces, for instance, is highly combustible when the elemental sulphur runs above 25 per cent. (For such plants, adequate fire protection, such as hose, plugs and accessories, should be instantly available.) Walls of acid-proof brick construction would be badly shaken by a flare even after ample explosion doors had blown open. Such conditions have been successfully met by lining a steel skeleton with Johns-Manville "transite board," a type of asbestos lumber which is not only acid proof but is an excellent heat insulator as well.

Combustible dust should evidently be removed from the neighborhood of the electrical discharges as rapidly as collected. Screw or drag conveyors are available for this service, but they should be made several times as strong as the designer ordinarily thinks is necessary so that they may break up and remove the wet, caked dust remaining after a fire has been extinguished without themselves breaking.

Ramsay Memorial Fund in America

It is the desire of the American Committee of the Ramsay Memorial Fund to make the fund an expression of the esteem for Sir William Ramsay in this country. Many have expressed a wish to contribute, but have held back on account of their inability to send in a sum commensurate with their esteem. This has been due to the numerous calls made upon all for the past two years. Small sums, from one to five dollars, will be welcomed by the Committee, which is anxious to make the expression of appreciation as widespread as possible. Contributions may be sent to Prof. Charles Baskerville, Chairman, College of the City of New York, or Mr. W. J. Matheson, Treasurer, 21 Burling Slip, New York City.

Furnace Settings for Caustic Pots

Designs of Radial, Tangential and Reversible Series Dutch Oven Type Furnace Settings for Counter Current Economizer Caustic Soda Pots—The Development of the Most Efficient Modern Types

BY FRANK H. NICKLE

IN the early furnace settings, adapted for firing caustic pots with coal, the pots were suspended by means of a wide flange at the rim, or a cast iron saddle ring, the weight of the pot in either case being carried by the surrounding brickwork. The grates were placed directly under the pot, thereby subjecting the bottom of the pot to the most intense heat. As larger pots came into use, it became desirable to support the pot on a central pier, thereby relieving the surrounding brickwork of the load and also protecting the lower extremities of the pot from an excess of heat, which had a tendency to interfere with the proper settling of the foreign matter in suspension in the caustic liquor.

An early design of a caustic pot setting is shown in Fig. 1, which is reproduced from the well known works of Lunge. The grates are placed adjacent to the central supporting pier, and within the confines of the brick wall that surrounds the pot. The furnace gases divide on the center line of the combustion chamber and travel 180 degrees in opposite directions around the pot.

The usual practice in this country has been along similar lines, with the addition of a Dutch oven to accommodate longer grates. The Dutch oven is built on the center line of the pot, so as to deliver the products of combustion radially toward the pot, the gases dividing on the center line and traveling in opposite directions around the pot to a common flue connection in the rear. To designate this type of construction, from the writer's improved designs, the same is termed the "radial Dutch oven type."

This radial Dutch oven type, Fig. 2, is illustrated by a battery of two direct-fired pots operating in con-

junction with a third or back pot, the back pot serving as an economizer or preheater for the recovery of waste heat from the flue gases. To prevent the direct impingement of the flame upon the pot, a V-shaped vertical fire guard or segmental apron is placed directly in front of the pot. The introduction of this fire guard, although affording a measure of protection to the pot, leads to other difficulties. It restricts the throats at the entrance of the heating passages. In some cases the area of these openings is only fifteen or twenty per cent of the grate surface. If these throats are made amply large, then the support of the rear end of the arch over the combustion chamber becomes a delicate matter, as the diverging walls do not afford suitable skewbacks at the spring line. This makes it necessary to corbel out the rear end of the arch toward the pot in a V-shaped manner, in order to provide a support for the circular brick wall that surrounds the pot directly above the combustion chamber. In this overloaded and weakened condition, the rear end of the arch is called upon to withstand the most intense heat, due to the direct impingement of the high velocity furnace gases and the radiant heat reflected from the fire guard.

The back pot, which serves as an economizer for both primary pots, is usually elevated so that a portion of the liquid contents may flow by gravity to the front pots. As illustrated in the plan view, the flue connection between the front and back pots is sometimes made as short as possible by locating the same on a center line drawn through the front and back pots. This reduces the floor space occupied by the pots; however, the fallacy is obvious. The travel of the heating gases,

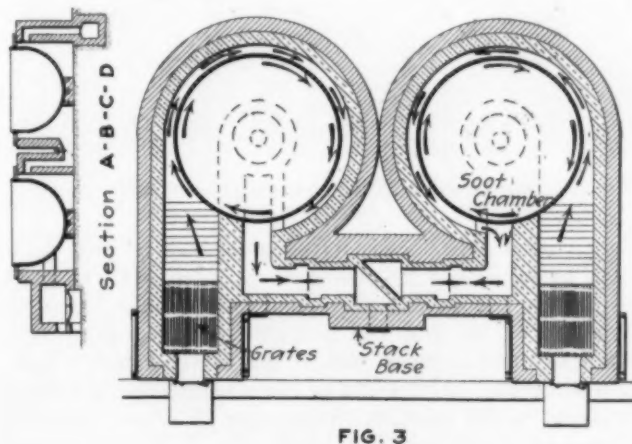
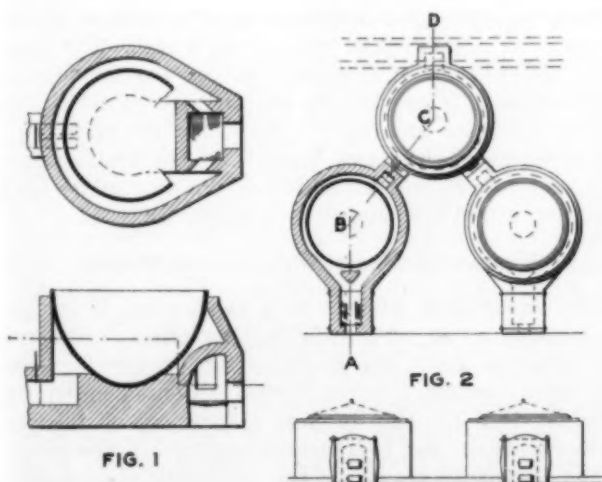


FIG. 1. EARLY DESIGN OF CAUSTIC POT SETTING. FIG. 2. RADIAL DESIGN OF CAUSTIC POT SETTING. FIG. 3. NICKLE TANGENTIAL DUTCH OVEN TYPE.

in active contact with the front pot, is reduced on one side and increased a like amount on the opposite. This unequal length of travel, about 140 and 220 degrees respectively, naturally causes the heating gases to short circuit and follow the shorter course. Consequently, only one side of the pot, adjacent to the shorter heating passage, is worked to capacity, the volume and velocity of the heating gases being deficient on the opposite side. This unequal distribution of the gases results in a poor natural circulation of the liquor undergoing concentration, also a low rate of heat transmission and

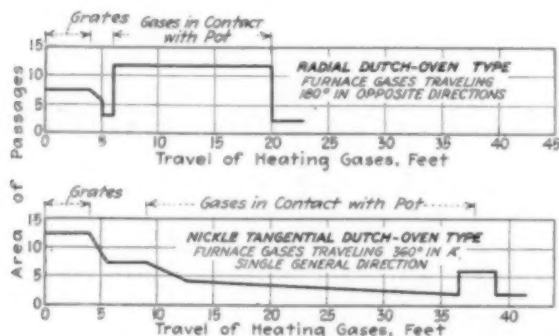
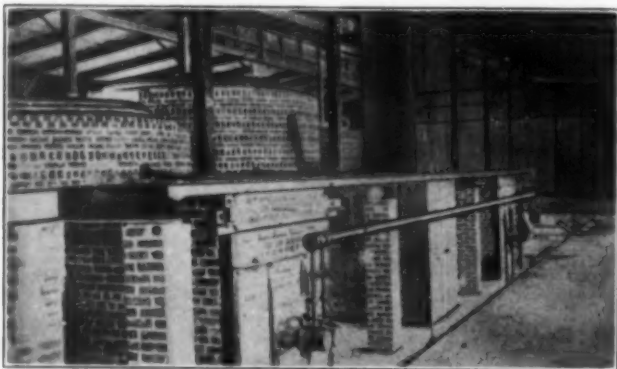


FIG. 4. RELATIVE AREA OF PASSAGES AND TRAVEL OF HEATING GASES.

high temperature flue gases, which makes the use of a back pot more or less imperative. The back pot setting, as illustrated, is subject to the same criticism, with respect to the unequal distribution of the heating gases, especially so when the firing of either of the front pots is curtailed.

TANGENTIAL DUTCH OVEN TYPE

One of the writer's improved types of furnace settings for caustic pots is shown in sectional plan in Fig. 3. This design, hereinafter termed the "tangential



A GAS FIRED FURNACE SETTING FOR CAUSTIC POTS.

Dutch oven type," consists of a battery of two pots, each being heated by means of a Dutch oven adapted to deliver the products of combustion tangentially to one side of the pot, the heating gases traveling substantially 360 degrees around the pot in a single general direction. At the end of the circumferential travel, adjacent to the combustion chamber, is a soot chamber with a clean-out door. A small sheet iron stack serves each battery, the stack base being located midway between the Dutch ovens.

The usual fire guard construction, to protect the pot

from local overheating, is omitted. This leaves the throat back of the bridge wall unrestricted. The area of the passage, where the furnace gases first come in contact with the heating surface, may be conveniently

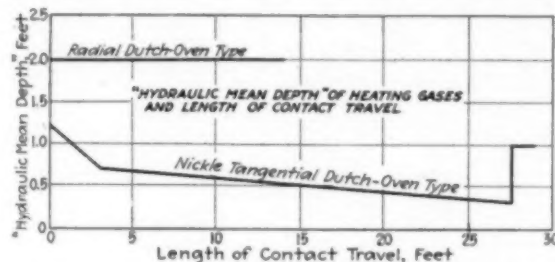


FIG. 5. CHART SHOWING DIFFERENCE BETWEEN THE TWO TYPES.

made equal to 50 per cent of the grate area. This large passage insures a uniform distribution of the gases over a relatively large area of heating surface. It reduces the initial velocity of the highly heated gases and eliminates the blowpipe effect. This desirable feature, together with the tangential application of the gases to the curved surface of the pot, prevents overheating at the initial point of contact.

As the rate of heat transmission is largely dependent upon the velocity of the heating gases, the area of the heating passage is gradually reduced until the end of the circumferential travel is reached. This offsets the

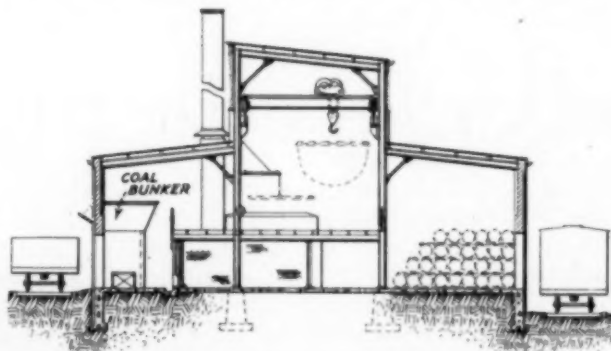


FIG. 6. SHORT SPAN BUILDING FOR CAUSTIC POT FURNACES.

reduction in volume of the gases due to cooling, increases the velocity and favors the effectiveness of the heating surface near the end of the travel. The relatively low velocity of the gases leaving the combustion chamber tends to prevent the entrainment of ashes and cinders from the fuel bed. Accelerating the velocity of the gases lessens the soot deposits in the heating passage and permits the deposition of the soot in the soot chamber, where the velocity is suddenly retarded.

"HYDRAULIC MEAN DEPTHS" CONSIDERED

The impartation of heat to a caustic pot is largely by convection, as very little heating effect is derived by radiation from the surrounding brickwork when the brick surface becomes sooted. Consequently, we may say that the rate of heat absorption, by the dry wall of a caustic pot, is largely determined by the length of the gas contact travel and the "hydraulic mean depth" or the average mean distances of the particles of gas from the heating surface.

Comparing the radial and tangential Dutch oven designs, see Fig. 4, the first condition, the length of the gas contact travel, is readily seen to be substantially doubled in the tangential Dutch oven type.

The second condition is not so easily apprehended. The "hydraulic mean depth" is the quotient of the area of the cross section of the gas stream divided by the perimeter formed by the heating surface of the pot touched by the gases. This may be expressed by saying that the closer the gas particles are directed to the pot surface, the more contacts they can make with it in a unit of time. In other words, the "hydraulic

in motion, act the same as a dry gas, the conducting power of which is inappreciable.

The rate of heat transfer, from the pot wall to the liquor, is largely dependent upon the contact velocity of the liquor. There must be an interchange of position between the hotter and the colder particles of liquor in order to permit the heat to flow by convection. The liberation of the steam bubbles is the impelling force that largely effects the desired circulation.

The question now naturally arises—how can the circulation of the liquor in a caustic pot be increased without resorting to mechanical means? The logical

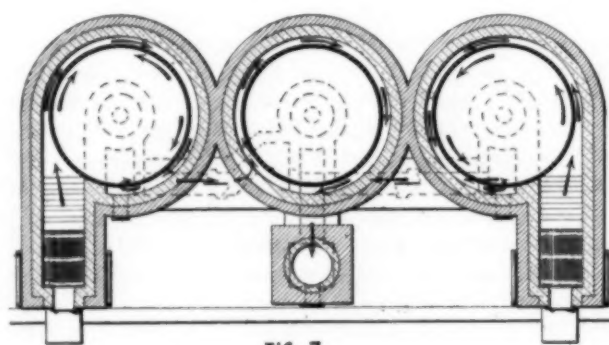


FIG. 7

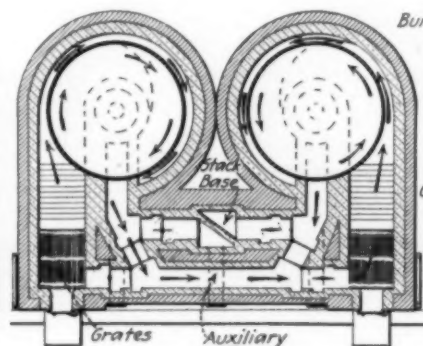


FIG. 8

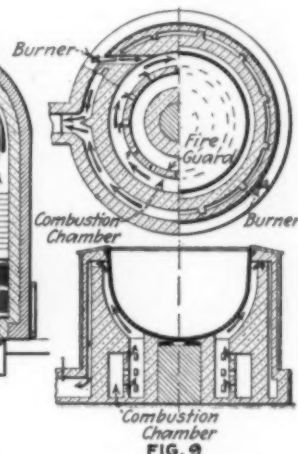


FIG. 9

FIG. 7. NICKLE TANGENTIAL DUTCH OVEN TYPE WITH TANGENTIAL DUTCH OVEN TYPE. FIG. 8. NICKLE REVERSIBLE SERIES. FIG. 9. NICKLE GAS FIRED TYPE.

mean depth" should be made as small as the draft conditions will permit.

The "hydraulic mean depths" for the two designs under consideration are shown graphically, at any point of travel along the heating passages, in Fig. 5. In each case the gassed perimeter is constant and may be taken as 6.0 feet. The "hydraulic mean depth" for the radial Dutch oven design is 2.00, and may be illustrated by a straight horizontal line, as the flue area is constant. For the tangential Dutch oven design, the "hydraulic mean depth" varies from 1.25 at the initial point of contact to 0.33 at the entrance of the soot chamber, the average being about 0.75.

ADVANTAGE OF THE TANGENTIAL DUTCH OVEN TYPE

A comparison of the average "hydraulic mean depths" for the two designs clearly illustrates the advantage of the tangential Dutch oven type. It indicates that the gases will make an average of 2.66 times as many contacts with the heating surface in a unit of time. To arrive at this comparison, the volume and temperature of the heating gases leaving the combustion chamber must be the same in each case, allowance being made, in the radial Dutch oven design, for the fact that there are two streams of gases.

Lack of adequate circulation in a caustic pot is also a check to efficient heat transmission. If there is no circulation, the liquor undergoing concentration, or heat treatment, abstracts heat from the pot wall by conduction, which implies no mechanical motion between the contact surfaces of the two bodies. All liquids at rest absorb heat by conduction very slowly. Likewise, a layer of steam bubbles on the heating surface, unless

answer is, to apply the heating gases to the exterior of the pot in a manner that will promote the rotation of the liquor in a horizontal direction about the axis of the pot. In the tangential Dutch oven type of pot setting, the natural circulation of the liquor is in a horizontal direction concurrent with the circumferential travel of the heating gases, as set forth in the writer's U. S. Patent No. 1,191,338, from which the following typical claim is quoted:

"In a furnace setting for caustic pots, the combination of a furnace, a caustic pot having liquor therein, means to cause the liquor to rotate, said means being the products of combustion applied tangentially to the exterior of the pot and traveling in a direction concurrent with the rotation of the liquor within the pot."

In causing the liquor to rotate in a substantially horizontal direction about the pot axis as a center of rotation, the only resistance encountered is the skin friction between the liquor and the pot wall, the scouring action of which is desirable, as it tends to rub the steam bubbles off the heating surface and promote better contact therewith.

Rotating the liquid contents of a caustic pot not only facilitates the abstraction of heat from the pot wall; it causes the foreign matter in suspension to float toward the center of rotation and settle down out of the zone of active circulation. It thus saves time in settling the highly concentrated or molten caustic soda, improves the appearance of the solid product, and reduces the amount of caustic bottoms to a minimum.

This tangential Dutch oven type of caustic pot setting was first installed, under the direction of the writer, during 1913, by the Dow Chemical Co. at Mid-

land, Mich. The initial installation consisted of four furnaces, which have been subsequently increased to a total of twenty-two. The fire brick arches over the Dutch ovens on the initial furnaces were renewed for the first time during the latter part of 1918, after having been in continuous service for a period of nearly five years. The successful operation of these furnaces has demonstrated the correctness of the principles involved in the tangential application of the heating gases to the pot in a single general direction. Without any economizer or back pot, these furnaces have proved



NICKLE TANGENTIAL DUTCH OVEN IN PROCESS OF CONSTRUCTION.

quite as economical in fuel consumption as the radial Dutch oven type with the usual third or back pot.

Omitting the third or back pot means a saving of about one-third of the investment. Aside from saving the expense of the back pot and the brick setting for the same, it involves a substantial reduction in building costs, as the tangential Dutch oven type is adapted for short span building construction. The general arrangement of a short span caustic shed is shown in cross-sectional elevation in Fig. 6. In this design, the floor space served by the traveling crane is reduced nearly one-half, as compared with the usual layout that accommodates the radial Dutch oven type employing back pots.

As shown in Fig. 7, a battery of two tangentially fired pots may be operated in series with an economizer or third pot. In this arrangement, the flue gases from both of the primary pots travel 360 degrees circumferentially in a single direction around the middle pot. An installation of this type, fired with natural gas, at the plant of the Warner-Klipstein Chemical Co., Charleston, W. Va., leads the writer to believe that the economy that may be effected by the third pot will not justify the extra investment under the average conditions.

A better way to recover waste heat from the flue gases, without resorting to the use of a third pot, is shown in Fig. 8. This design is the same as the tangentially fired two-pot battery shown in Fig. 3, with the addition of an auxiliary flue and the necessary dampers to enable the operation of the furnaces in reversible series or parallel. When operating in series, either pot may be fired as a primary, while the other serves as a secondary for preheating and effecting the initial concentration of the fresh caustic liquor by means of waste flue gases from the primary pot. A reversal of the dampers converts the secondary pot into a primary and vice versa. The evaporation in the secondary

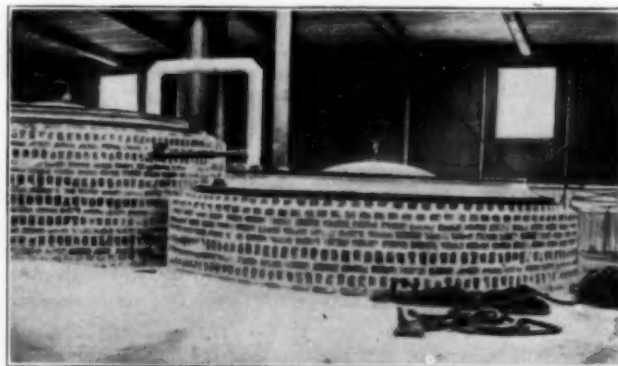
pot may be increased by firing the same lightly to augment the heating effect of the flue gases from the primary setting, otherwise, if desirable, the fire in the secondary Dutch oven may be banked.

ANOTHER NEW TYPE

Another new type of furnace setting, adapted for caustic pots and various kinds of retorts, is shown in Fig. 9. The following extracts from the writer's pending patent application will suffice for description:

This furnace setting is designed especially for firing caustic pots or other containers with crude oil or gas. An annular combustion chamber, located below the pot and concentric therewith, is made to deliver the products of combustion through a plurality of radial ducts spaced circumferentially in a fire guard that surrounds the circular pier upon which the pot rests. The combustible is supplied by hydro-carbon burners arranged to deliver the blast tangentially to the exterior of the fire guard and in the same general direction of rotation. The radial ducts in the fire guard being at right angles to the direction of the blast, it is evident that the burning gases are caused to travel a considerable distance before gaining entrance to the heating passage at the bottom of the pot.

The endless travel and swirling motion assure a thorough mixing of the burning gases, while the same are being intensely heated by the radiant heat from the wall that surrounds the combustion chamber. This insures good combustion before the gases are subjected to the chilling effect of the comparatively cold heating surface of the pot. The distribution of the gases is uniform around the pot supporting pier, the travel being upward while in contact with the heating surface. This uniform distribution of the gases, without direct impingement of the flame upon the pot, favors the life of the pot. There is no occasion to turn the



COMPLETED INSTALLATION OF NICKLE TANGENTIAL DUTCH OVEN.

pot at intervals to distribute the wear, as is the custom when other types of furnace settings are employed.

Another characteristic peculiar to this type of furnace setting is the use of the waste flue gases for heating the exterior of the fire wall that surrounds the combustion chamber and the pot, the object being to reduce heat losses therefrom by a reduction in the temperature range between the inner and outer faces of the fire wall. An outer wall, concentrically spaced from the fire wall and joined thereto at regular intervals with radial slip-joints, forms a plurality of downtake passages circum-

ferentially arranged and adapted to withdraw the flue gases from the top of the heating passage that surrounds the pot. This construction also provides for a differential rate of expansion and contraction between the inner and outer fire brick walls.

The use of this type of furnace construction is not confined to caustic pots. About thirty furnaces of this type have been installed for the manufacture of carbon bisulphide.

Chemical Engineer,
Saginaw, W. S., Mich.

Platinum Economy in the Industrial Chemical Laboratory

BY E. C. MUESER

THE present high price of platinum and recently the real difficulty of obtaining this metal due to Government restrictions in behalf of its conservation for essential war industries, among which were its use in sulphuric acid plants for concentrating pans, its use as contact metal, as catalyzer and other uses, have made it necessary to conserve carefully the analytical laboratory supply of platinum ware. In many laboratories, in order to avoid great expense in replacing this ware and inconvenience due to its shortage caused by difficulty in obtaining new platinum, it was found necessary to make a careful study of the economy of the platinum-ware equipment of the laboratory.

Aside from the importance of conserving platinum ware to avoid analytical inconveniences caused by difficulty in replacing, the platinum of the average laboratory represents a considerable percentage of the total equipment investment, and its rapid deterioration, due to careless or ignorant use, adds very materially to the maintenance and operating costs of the laboratory. In view of these considerations it seems timely to call attention to some basic principles for the proper use of platinum in the chemical laboratory. The first step in conserving platinum ware is, of course, restriction of its use to operations where it is absolutely necessary, that is, where laboratory apparatus, such as crucibles, of iron, nickel, nichrome, alundum or platinum "substitutes" cannot be used because of the nature of the material and the nature of the operation. When platinum ware must be used a careful attention to its proper use will double or triple the life of platinum crucibles and other platinum ware in the laboratory.

The proper care of platinum ware is a matter to which many laboratories have not given the attention demanded by the large investment it represents. In many laboratories platinum ware is frequently ruined through the analyst's carelessness and through ignorance of unskilled routine workers. The proper use of platinum ware should be carefully prescribed in all laboratories and should be restricted to its necessary uses, instead of permitting its use whenever convenient. Some of the platinum substitutes, which, however, are also high priced, may be recommended, and the laboratory chief will find these suited to much of the work which is usually done in platinum. But besides these a large stock of crucibles and ware of silver,

nichrome, iron, quartz, alundum, nickel, lead, clay, porcelain and other materials should be on hand, and instructions posted advising for what work crucibles of these various materials are suited. It will be found in many cases that one or another of these materials is very well adapted to the work in which platinum has previously been used.

Many routine analysts work under the impression that platinum is inert to almost any chemical with which he may happen to be working, and some "Dont's" and "Instructions" for its proper use, if posted in the laboratory, would no doubt prevent the ruin of much platinum. In such posters the analyst should be instructed what materials ruin platinum at high temperatures. He should be informed never to place platinum ware in the bare flame or heat it to a temperature approaching a red heat while it contains compounds of lead, antimony, arsenic, silver, tin or bismuth. Also that alkaline earths and caustic alkalies corrode it when heated as well as nitrates and cyanides and sulphur in alkaline mixture. Carbonaceous materials should never be burned in contact with platinum, since small quantities of silica carried by the ash of these materials are reduced by the carbon and combine with platinum, causing it to become brittle.

In heating platinum in the bare bunsen flame it should never be lowered into the reducing cone, but should always be heated in the top invisible parts of the flame. This is also the hottest zone of the flame. The inner cone of a gas flame contains carbon particles and partly burned carbon, which soon crystallizes the platinum and causes it to become brittle due to the formation of a carbide of platinum. If precipitates with their filter paper are ignited in platinum, damage is sometimes caused to the crucible due to the reducing action of the paper. Phosphates and other materials which may injure platinum when reduced in this way should be ignited in porcelain.

Finally, economy and preservation of platinum ware require its proper cleaning. Among the cleaning agents most used are moist sea-sand, with which the platinum is scoured. In some cases fusion with potassium bisulphate may be necessary to clean the metal surface, or sodium amalgam may occasionally be used according to the well known practice.

All the above is of course well known to the average chemist, and the various suggestions made are common practice in all well regulated laboratories. However, in view of the recent difficulty in obtaining new platinum ware and the large investment which the platinum equipment of most laboratories represents, it seemed pertinent again to call attention to some of these rules for the preservation and care of platinum. If calling attention to this matter may help in a little way to extend the life of platinum ware in some laboratories where its conservation and proper use have been neglected, the above will serve its purpose and may assist in conserving the nation's supply of platinum for many essential operations in our industries, in some of which it still finds sole application. Besides this, careful attention to platinum practice may assist in reducing the operating cost in the laboratory where much routine work is handled by analysts with meager technical training.

Badin, N. C.

Dyes and Other Coal-Tar Chemicals

Amendments Recommended to Congress by U. S. Tariff Commission to the Tariff Act of Sept. 8, 1916, Title V on Coal-Tar Crude, Intermediate and Finished Chemicals—New Act to Be Specific—Reasons for Changes

THE United States Tariff Commission has recommended to Congress that the amendments to Title V on Dyestuffs of the act of September 8, 1916, be enacted according to the following edited text, the deleted matter of original act being in brackets and the proposed substitutions or additions in italics. The former act was not sufficiently specific since there were recognized ways of evading duty charges through alternative classifications on such commodities as salol, saccharin, sodium benzoate, phenolphthalein, acetanilid, acetphenetidin, antipyrine, acetylsalicylic acid, aspirin, coumarin, oil of wintergreen, trinitrotoluol, etc. The numbers within the brackets refer to explanatory notes abstracted from the report of Dr. Grinnell Jones on the Reasons for the Proposed Amendments. The full report forms a booklet of 83 pages which is now ready for distribution and to which the reader should refer for further details than given here.

TEXT SHOWING PROPOSED AMENDMENTS

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Title V of an act entitled "An act to increase the revenue, and for other purposes," approved September 8, 1916, be and hereby is amended to read as follows:

TITLE V.—DYESTUFFS

Sec. 500. That on and after the day following the passage of this act, except as otherwise specially provided for in this title, there shall be levied, collected, and paid upon the articles named in this section when imported from any foreign country into the United States or into any of its possessions, except the Philippine Islands and the islands of Guam and Tutuila, the rates of duties which are prescribed in this title, namely:

FREE LIST

Group 1. Acenaphthene, anthracene having a purity of less than (3) [twenty-five] *thirty* per centum, benzol, carbazol having a purity of less than (4) [twenty-five] *sixty-five* per centum, (5) [cresol] cumol, (7) *cymene*, fluorene, (6) [metacresol having a purity of less than ninety per centum] methylanthracene, methylnaphthalene, naphthalene having a solidifying point less than seventy-nine degrees centigrade, (6) [orthocresol having a purity of less than ninety per centum, paracresol having a purity of less than ninety per centum] pyridin, quinolin, toluol, xylol, dead or creosote oil, anthracene oil, pitch of coal tar, (1) *pitch of blast-furnace tar, pitch of oil-gas tar, pitch of water-gas tar, crude coal tar, (1) crude blast-furnace tar, crude oil-gas tar, crude water-gas tar, all other distillates (5) of any of these tars which on being subjected to distillation yield in the portion distilling below (5) [two hundred] one hundred and ninety degrees centigrade a quan-*

tity of tar acids less than five per centum of the original distillate, (2) *all mixtures of any of these distillates and any of the foregoing pitches, and all other products that are found naturally in coal tar, whether produced or obtained from coal tar or other source, and not otherwise specially provided for in this title, shall be exempt from duty.*

DUTIABLE LIST

Group II. (10) *Acetanilid not suitable for medicinal use*, (11) *alphanaphthol*, (13) *amidobenzoic acid*, *amidonaphthol*, (13) *amidophenetol*, *amidophenol*, *amidosalicylic acid*, (13) *aminoanthraquinone*, *anilin oil*, *anilin* (12) [salts] *salt*, *anthraquinone*, (13) *arsanilic acid*, *benzaldehyde* (8) *not suitable for medicinal use*, (13) *benzalchloride*, *benzanthrone*, *benzidin*, (13) *benzidin sulphate*, *benzoic acid* (8) *not suitable for medicinal use* (13) *benzoquinone*, *benzoylchloride*, *benzylchloride*, (11) *betanaphthol not suitable for medicinal use*, (13) *brombenzol*, *chlorbenzol*, *chlorophthalic acid*, (13) *cinnamic acid*, *cumidin*, (13) *dehydrothiitoluidin*, *diaminostilbene*, *dianisidin*, (13) *dichlorphthalic acid*, *dimethylanilin*, (13) *dimethylamidophenol*, *dimethylphenylenediamin*, (12) [binitrobenzol] *dinitrobenzol*, [binitrochlorobenzol] *dinitrochlorobenzol*, *binitronaphthalene*, *dinitronaphthalene* (13) *dinitrophenol*, (12) [binitrotoluol] *dinitrotoluol*, *dioxynaphthalene*, (12) [diphenylamin] *diphenylamin*, (13) *ethylbenzylanilin*, *hydroxyphenylarsinic acid*, *metanilic acid*, *methylanthraquinone*, (11) [naphthol] *naphthylamin*, *naphthylendiamin*, *nitranelin*, (13) *nitroanthraquinone*, *nitrobenzaldehyde*, *nitrobenzol*, *nitronaphthalene*, (13) *nitrophenol*, *nitrophenylenediamin*, (13) *nitrosodimethylanilin*, *nitrotoluol*, *nitrotoluylenediamin*, *phenol*, *phenylenediamin*, (13) *phenylhydrazine*, *phenylnaphthylamin*, (13) *phenylglycocol*, *phenylglycocolthocarboxylic acid*, *phthalic acid*, *phthalic anhydride*, (13) *phthalimid*, *resorcin* (8) *not suitable for medicinal use*, *salicylic acid* (9) *and its salts* (8) *not suitable for medicinal use*, *sulphanilic acid*, (14) *thiocarbamilid*, (13) *thiosalicylic acid*, *tetrachlorphthalic acid*, *tetramethyldiaminobenzophenone*, *tetramethyldiaminodiphenylmethane*, *toluol sulphochloride*, *toluol sulphamid*, *tribromphenol*, *toluidin*, *tolidin*, *toluylenediamin*, *xylidin*, or any sulphoacid or sulphoacid salt of any of the foregoing, (15) *or of any of the products provided for in Group I*; (16) [all similar products obtained derived, or manufactured in whole or in part from the products provided for in Group I] *all other products by whatever name known which are employed in the manufacture of any of the products provided for in Group II or III and which are obtained, derived, or manufactured in whole or in part from any of the foregoing or from any of the products provided for in Group I*; anthracene having a purity of (3) [twenty-five] *thirty* per centum or more, carbazol having a purity of (4) [twenty-five] *sixty-five* per centum or more, metacresol having a purity of

ninety per centum or more, naphthalene having a solidifying point of seventy-nine degrees centigrade or above, orthocresol having a purity of ninety per centum or more, paracresol having a purity of ninety per centum or more; all distillates (17) of coal tar, blast-furnace tar, oil-gas tar, and water-gas tar which on being subjected to distillation yield in the portion distilling below (17) [two hundred] one hundred and ninety degrees centigrade a quantity of tar acids equal to or more than five per centum of the original distillate; (18) all mixtures, including solutions, consisting in whole or in part of any of the foregoing except sheep dip and medicinal soaps, not otherwise specially provided for in this act; all the foregoing not colors, dyes, or stains, (19) color acids, color bases, color lakes, leuco-acids, leuco-bases, indoxyl, indoxyl compounds, ink powders, photographic chemicals, medicinals, flavors, (19) resinlike products, synthetic tanning materials, or explosives, and not otherwise specially provided for in this title, (20) [and provided for in the paragraphs of the act of October third, nineteen hundred and thirteen, which are hereinafter specifically repealed by section five hundred and two] fifteen per centum ad valorem.

Group III. All colors, dyes, or stains, whether soluble or not in water, color acids, color bases, color lakes, (21) leuco-acids and leuco-bases whether colorless or not, indoxyl and indoxyl compounds; (22) ink powders; photographic chemicals; (23) [medicinals] acetanilid suitable for medicinal use, acetphenetidin, acetylsalicylic acid, antipyrine, benzaldehyde, suitable for medicinal use, benzoic acid suitable for medicinal use, betanaphthol suitable for medicinal use, phenolphthalein, resorcin suitable for medicinal use, salicylic acid and its salts suitable for medicinal use, salol, and other medicinals; (24) sodium benzoate; (25) saccharin, (26) methyl salicylate, (27) coumarin, and other flavors; synthetic phenolic resin (28) and all resinlike products prepared from phenol, cresol, phthalic anhydride, coumaron, indene or from any other article or material provided for in Group I or II, all of these products, whether in a solid, semisolid, or liquid condition; (29) synthetic tanning materials; (30) [or explosives] (31) [not otherwise specially provided for in this title] (30) picric acid, trinitrotoluol, and other explosives except smokeless powders; (32) all of the foregoing when obtained, derived, [or] manufactured in whole or in part from any of the products provided for in (33) [Groups] Group I (33) [and] or II; natural alizarin and (34) natural indigo, and colors, dyes (34) stains, color acids, color bases, [or] color lakes, (34) leuco-acids, leuco-bases, indoxyl and indoxyl compounds obtained, derived, or manufactured (34) [therefrom] in whole or in part from natural alizarin or natural indigo; (26) natural and methyl salicylate or oil of wintergreen or oil of sweet birch; (27) natural coumarin, (35) and all mixtures, including solutions, consisting in whole or in part of any of the articles or materials provided for in this group, thirty per centum ad valorem.

Sec. 501. That on and after the day following the passage of this act, in addition to the duties provided in section five hundred, there shall be levied, collected, and paid upon all articles contained in Group II a special duty of 2½ cents per pound, and upon all articles contained in Group III (36) [(except natural and synthetic alizarin and dyes obtained from alizarin, anthracene,

and carbazol; natural and synthetic indigo and all indigoids whether or not obtained from indigo; and medicinals and flavors)] a special duty of 5 cents per pound: (37) *Provided, That the special duties herein provided for on colors, dyes, or stains, whether soluble or not in water, color acids, color bases, color lakes, leuco-acids, leuco-bases, indoxyl and indoxyl compounds, shall be based on standards of strength which shall be established by the Secretary of the Treasury, and that upon all importations of such articles which exceed such standards of strength the special duty of 5 cents per pound shall be computed on the weight which the article would have if it were diluted to the standard strength, but in no case shall any such articles of whatever strength pay a special duty of less than 5 cents per pound: Provided further, That, beginning six months after the date of passage of this act, no package containing any such color, dye, stain, color acid, color base, color lake, leuco-acid, leuco-base, indoxyl, or indoxyl compound shall be admitted to entry into the United States unless such package and the invoice shall bear a plain, conspicuous, and truly descriptive statement of the identity and percentage exclusive of diluents, of such color, dye, stain, color acid, color base, color lake, leuco-acid leuco-base, indoxyl or indoxyl compound contained therein: And provided further, That, beginning six months after the date of passage of this act, no package containing any such article shall be admitted to entry into the United States if it, or the invoice, bears any statement, design, or device regarding such article or the ingredients or substances contained therein which is false, fraudulent, or misleading in any particular. In the enforcement of this section the Secretary of the Treasury shall adopt standards of strength which shall conform as nearly as practicable to the commercial strengths in use in the United States prior to July first, nineteen hundred and fourteen.*

(38) [During the period of five years beginning five years after the passage of this act] *Beginning September ninth, nineteen hundred and twenty-one, such special duties shall be annually reduced by twenty per centum of the rate imposed by this section (38) [so that at the end of such period] until September eighth, nineteen hundred and twenty-five, after which date such special duties shall no longer be assessed, levied, or collected, (39) [but if, at the expiration of five years from the date of the passage of this act, the President finds that there is not being manufactured or produced within the United States as much as sixty per centum in value of the domestic consumption of the articles mentioned in Groups II and III of section five hundred, he shall by proclamation so declare, whereupon the special duties imposed by this section on such articles shall no longer be assessed, levied, or collected.]*

(40) *The Secretary of the Treasury is hereby authorized to make regulations for the enforcement of the provisions of this title.*

Sec. 502. That paragraphs twenty, twenty-one, twenty-two, twenty-three, (41) *one hundred and seventy-nine, three hundred and ninety-four, four hundred and fifty-two, and five hundred and fourteen, and the (41) [words "salicylic acid" in paragraph one of Schedule A of section one] provision for salicylic acid in paragraph one; and provisions for salol, phenolphthalein, acetanilid, acetphenetidin, antipyrine, acetylsalicylic acid, and as-*

pirin in paragraph eighteen; and the provision for benzoate of soda in paragraph sixty-seven; and the (41) [words "carbolic" and "phthalic"] provisions for carbolic and phthalic acids in paragraph three hundred and eighty-seven (41) [of the "free list" of section one of said act] (43) [and so much of said act or any existing law or parts of law as may be inconsistent with this title are hereby repealed] of an act entitled "An act to reduce tariff duties and to provide revenue for the Government, and for other purposes," approved October third, nineteen hundred and thirteen, are hereby repealed: (42) *Provided, That all articles which may come within the terms of paragraphs one, five, thirty-seven, forty-six, sixty-three, five hundred and one, and five hundred and thirty-eight of said act of October third, nineteen hundred and thirteen, as well as within the terms of Group I, II, or III of section five hundred of this act shall be assessed for duty or exempted from duty, as the case may be, under this act.*

Sec. 503. (44) *That on and after the day when this act shall go into effect all of the foregoing goods, wares, and merchandise previously imported, for which no entry has been made, and all of the foregoing goods, wares, and merchandise previously entered without payment of duty and under bond for warehousing, transportation, or any other purpose, for which no permit of delivery to the importer or his agent has been issued, shall be subject to the duties imposed by this act and to no other duty, upon the entry or the withdrawal thereof: Provided, That when duties are based upon the weight of merchandise deposited in any public or private bonded warehouse, said duties shall be levied and collected upon the weight of such merchandise at the time of its entry.*

Sec. 504. (45) *Except as otherwise herein specially provided, this act shall take effect on the day following its passage.*

REASONS FOR THE PROPOSED AMENDMENTS

1. These tars, although similar to coal tar in chemical nature, and yielding similar products or distillation, are not identical. . . . This close similarity makes it advisable to put all the tars on the same basis.

2. In order to insure tarred oils, etc., being retained on the free list instead of being classified under paragraph 5 of the Act of 1913, the amendment quoted above is proposed.

3. Anthracene is obtained by distilling tar to hard pitch at temperatures around 300 deg. C. When the distillate is cooled, crude anthracene, containing from 25 to 30 per cent anthracene, 15 to 20 per cent carbazol, 20 per cent phenanthrene, crystallizes and can be mechanically separated. The next step is to extract the phenanthrene with an oil solvent, which gives a product containing from 35 to 50 per cent anthracene, which can be further concentrated to 80 per cent anthracene by extracting the carbazol with another solvent. This 80 per cent grade is suitable for the manufacture of intermediates directly.

4. The change was introduced to make only the refined carbazol dutiable.

5. It is evident that considerable orthocresol will distill at a temperature of 200 deg. C. (B. Pt. of phenol 191 deg. C.; orthocresol, 191 deg. C.; metacresol and paracresol, each, 202 deg. C.) The alteration is designed to protect the phenol industry and not put a duty on the primary cresol oils.

10. Acetanilid appears in commerce in two grades—medical and technical (an intermediate).

11. Betanaphthol of a medicinal grade should be dutiable in Group III.

12. The hydrochloride of anilin is usually commercially designated by this term.

14. Thiocarbanilid, made from anilin and carbon bisulphide, promises to be of importance as a rubber vulcanization accelerator and is arbitrarily classed in Group II.

21. The use of the term "leuco" has been broadened to include compounds chemically analogous to the original "leuco compounds" even if not colorless—products converted to dyes by an oxidation agent.

22. A dye which might be classed as an ink powder and be consumed in textile dyeing.

28. The products resemble the resins in some physical properties but are different chemically. The term "phenolic" is unduly restrictive—cresol, phthalic anhydride, coumaron and indene should be included.

36. The only dyes of these classes which were made in the United States during 1917 were indigo, dibromindigo and alizarin. The production of indigo during 1917 was 274,771 lb.—made entirely by one company. At the close of 1918, three companies were manufacturing indigo at a rate equal to normal consumption. It is reported that 1,921,327 lb. of "indigo extract" were made from imported natural indigo. Alizarin was refined on a large experimental scale by one producer. Some so-called "alizarin" or "anthracene" dyes were marketed: "alizarin yellow," an azo dye derived from anilin; "alizarin brown" or "anthracene brown," from phthalic anhydride and gallic acid.

37. It is suggested that a specific duty shall be levied on the basis of the usual commercial strength. It is required that the identity and percentage shall be disclosed to facilitate the assessment of both the ad valorem and specific duties.

An Example of Crystal Crushing

In making physical tests of shell steel, it has come to the writer's attention that certain test bars show a very peculiar structure after fracture. The fractured surface shows a crystalline structure with the exception of a spot in the approximate center of the bar which shows a granular and often a silky appearance. This spot varies from approximately one-quarter to one-half the area of the cross section of the test bar. The writer's first opinion was that during the heat treatment of the bar in question the soaking time before the quench was insufficient. In other words, the time was not sufficient to allow the interior of the test bar to reach the critical temperature.

Subsequent investigations disproved this theory, for upon further examination, by taking another section of the same bar and etching, the grain size showed uniform throughout the entire cross section. By notching and fracturing (by impact), another part of the same test bar showed a uniform crystalline structure throughout. These investigations evidently disprove the theory that the heat treatment was not uniform, but indicate rather strongly that the crystals in the interior of the bar were crushed during the elongating of the bar before rupture.

In the writer's opinion, under certain favorable circumstances, this crushing may extend throughout the entire cross section of the test bar. This may lead to erroneous conclusions as to the condition of the steel. The fracture of a test specimen may be reported as silky or granular when in reality it should have been crystalline.

The metal used in the foregoing investigations was a medium carbon steel. The carbon ranged from 0.45 to 0.55 and the manganese from 0.60 to 0.80. The heat treatment was standard for this class of steel. The test bar was cut from a heat treated 4.7-inch common steel shell, taken from the regular production of the Milton Manufacturing Co.'s plant at Milton, Pa.

Electric Furnaces in the Steel Industry and Their Relation to the Central Station Business

Present Status of Electric Steel Furnace Installations and Their Characteristics in the United States— Electric Power Costs and Rate Schedules—Benefit of Off-Peak Load Hour Operating

GENERAL uses of electricity in the steel industry in the past few years have brought this industry to the attention of electrical engineers as perhaps the largest immediate field for new applications of electricity and large requirements for electric power. Foundries, rolling mills and all forms of steel fabricating plants are so rapidly adopting equipment which requires large amounts of electric power that the question of providing the necessary power is one which demands special attention. These uses of power are varied and some of them are more or less complex, so the services of competent electrical men, either in attendance or available for emergency call, are necessary. These uses comprise general motor drive, rolling mill motor drive requiring special control equipment, welding service for arc, spot and butt welding, oven service for heat treating furnaces, core baking ovens, enameling ovens, etc., lighting service and, lastly, by far the largest of all, service for electric steel furnaces. Electric furnaces require relatively large amounts of power, and their adoption in medium size plants often increases the demands for power as much as 1000 per cent. Since the electric melting furnace is of most vital importance at this time, the following comments will refer particularly to this type of equipment.

ELECTRIC STEEL FURNACES

There are, according to reports, now in the neighborhood of 300 electric steel furnaces in operation in America. Some of them are located in large steel plants, but the greater number are located in small and medium size steel foundries. Extension in the use of these furnaces is dependent upon an adequate supply of reliable electric power, available at a rate that will enable electric furnace steel to compete with steel produced in other types of furnaces. It is important that the cost of power be as low as the economies of modern large generating and distributing systems will permit, but it is equally important that the supply be adequate and that the service be reliable. Electric furnace installations are invariably followed by complete electrification of the steel plants, and in view of the fact that steel plant operators in general cannot expect to be thoroughly familiar with the various types of electrical equipment involved, it is important that competent electric service men be available for immediate call in case of trouble or in case changes are necessary or additional equipment is required.

Relatively few electric furnaces have been installed in this country excepting where power has been available from the lines of power companies. For this reason furnace manufacturers throughout the early stages of the development have worked hand in hand with

power companies, and it should be recognized that the status of the electric furnace to-day is in no small degree due to the careful and persistent efforts of power company industrial and operating engineers.

FURNACE ELECTRICAL CHARACTERISTICS

Electric arc steel furnaces have operating characteristics quite different from those of any other electric-power-using equipment. In the early stages of their development chief consideration was given to thermal efficiency, and with this idea in mind a number of furnaces were constructed which proved to have very objectionable electrical characteristics. Among these were induction furnaces with a power factor so low that power could not be supplied to them either satisfactorily or economically. The single phase, long arc furnace followed, which gave not only an intolerably low power factor but required single phase power, placing an unbalance on the generally used three phase power distributing system which introduced difficulties in power distribution that were very objectionable. It was soon found that three phase, short arc furnaces equipped with suitable regulators could be made and would not only accomplish all of the metallurgical requirements but would draw a practically balanced load from a three phase line and produce a minimum of load surging and voltage fluctuation on the line. Furnaces of this type immediately appealed to the electrical men as a step in the desired direction and demonstrated that there is no further necessity to supply power to a low power factor or single phase furnace, unless perhaps to some of very small capacity. We may therefore now consider single phase and low power factor furnaces out of the question and impracticable on account of electrical difficulties.

With even the most improved types of furnaces it is necessary to obtain power from a relatively large generating capacity and to have adequate conductors all of the way from the generators to the furnace. There are wide variations in the power load during a heat, particularly in the melting down stages of a heat of cold scrap. In this period there is a series of instantaneous short circuits causing very heavy loads, interspersed with conditions where the metal changes position and the load is very light. The result is a series of sudden load fluctuations which make it extremely difficult to maintain reasonably constant voltage on the lines and at the generating plant. Unless the power station generating capacity is many times greater than the load drawn by the furnace and unless the lines to the furnace are amply large, the effects of the load fluctuations at the furnace will reverberate through the transmission and generating system to such an extent that the

power plant will be unable to supply other power loads with any degree of satisfaction. For this reason a power company with a small central station should consider the possible effects of a furnace load quite carefully before agreeing to supply it.

SOURCES OF POWER

While electric power for a steel furnace may be obtained either from the lines of a power company operating steam or water power plants, or from a special or isolated power plant employing any suitable form of generating equipment, the electrical characteristics of large arc furnaces are such that they can be supplied with power far more satisfactorily and economically from a large generating and distributing system than from a relatively small isolated power plant. Variation in the electric load of a furnace during a heat and sudden heavy loads drawn from the line due to short circuits in the early stages of a heat make it necessary to have generating equipment for an isolated plant at least twice as large as the average load drawn by the furnace. This makes the investment in power plant equipment high, and the low load factor resulting would cause relatively high operating costs. In view of the fact also that furnace installations of from 1½ to 5 tons capacity require a total investment of between \$25,000 and \$50,000, it would be hardly practicable for the steel company to make an additional investment in power plant equipment in the neighborhood of \$100,000.

The usual practice is to obtain power from a central station generating plant and distributing system of as large capacity as is available. It matters not, except in the question of rates in some cases, whether the power is generated by steam or water power. In addition to having large generating capacity and heavy feeders necessary to supply furnace power, central stations usually have an adequate construction and trouble force available for taking care of troubles, repairs and additions in connection with the electric equipment. This, I believe, has been found to be an extremely valuable asset to the steel company in practically every case.

POWER COMPANIES LEARNING BY EXPERIENCE

Power companies have had to learn the characteristics of electric arc furnaces by experience. A number of them have held back on supplying power until they saw the effects of a furnace load and obtained some definite information regarding a rate for furnace power equitable from the power companies' standpoint. Some of them, however, of a more pioneering nature, took chances on some of the early installations and have spent large amounts of time and money in helping to develop furnaces to the point they have reached today. Successful future operation of electric steel furnaces will doubtless depend to a large extent upon close coöperation among furnace builders, steel plant operators and power companies, and it therefore behooves those in these different branches of industry to work together. If the proper types of furnace and accessory equipment are installed so the electric loads will not be too difficult to take care of on a standard power system and if the business will bear a remunerative rate, power companies will be more than glad to supply all of the electric power required and also will contribute quite

materially in the line of coöperation in the installation and maintenance of the furnace equipment.

ELECTRIC POWER COSTS

In the operating costs of an electric steel furnace, power is one of the appreciable items. In melting down cold scrap as in foundry work, it often amounts to about 20 per cent of the melting cost. This varies, of course, with the cost of labor and scrap and it also varies with the type of furnace used and the conditions of operation. Under normal nonwar conditions 1c. per kw.-hr. is a very reasonable rate for furnace power, but under present war conditions 1½c. per kw.-hr. is not unreasonable. There is probably little variation in the amount of power used and consequently in the power cost for the different types of the latest improved furnace, the greatest variation being due to the size of furnace used for a given output and the manner in which it is operated. A given capacity of electric power involves a fixed investment and carrying charge, whether it is obtained from an isolated power plant or from a power company, and with the necessary capacity provided and these charges once established they must obviously be distributed over the number of tons of steel melted by the furnace.

ELECTRIC POWER RATE SCHEDULES

In most cases electric power in the quantities required by steel furnaces is sold under a rate schedule having two factors: (1) a demand charge, or price per kilowatt for the maximum use of power during any given period in a month, such as ten, fifteen or thirty consecutive minutes; and (2) an energy charge, or price per kilowatt-hour for energy used in a month as measured by an integrating wattmeter. The demand charge covers the fixed carrying charges on power station, generating equipment and distribution system investment, and the energy charge covers the variable costs involved in the generation and distribution of electric power, such as fuel, labor, supplies and line losses.

On a two charge rate schedule it is apparent that the resultant rate per kw.-hr. earned is dependent to a large extent upon the number of hours the maximum demand is used in a month, because the demand charge is established by the use of power for a given short period, of say fifteen consecutive minutes, and is the same for the month in question whether power is used for fifteen minutes or 730 hours. The energy charge depends upon the total number of kilowatt-hours used, but there are often decreasing steps in the energy charge schedule so that the greater the quantity of power used the more will be obtained on the lower steps of the rate and accordingly the total net resultant rate will be decreased. This form of rate schedule is perfectly fair to the power user and it is practically the only equitable form of rate schedule under which a power company can furnish power, particularly steam generated power.

Obviously, the advantageous method in operating an electric furnace is to operate it as many hours a day as possible. If a 6-ton furnace operating ten hours a day will take care of a foundry's requirements, they can be taken care of also by a 3-ton furnace operating twenty hours a day. Night forces of men doubtless do not work quite as efficiently as day forces and in a close

labor market they are harder to maintain, but only a few men are required in melting and pouring gangs and in view of the apparently lower power cost that can be achieved there is a decided advantage in operating at night. This may be shown by the following example:

ADVANTAGES OF OPERATING AT NIGHT

Suppose we have to melt 234 tons of steel per month and consider using either a 3-ton furnace making three heats a day or a $1\frac{1}{2}$ -ton furnace making six heats a day; assume that the 3-ton furnace requires a maximum fifteen-minute demand of 900 kw. and the $1\frac{1}{2}$ -ton furnace a demand of 450 kw., that 550 kw.-hr. per ton melted are required in either case and that electric power is purchased under the following rate schedule:

Demand Charge—200 kw. at \$1.67 per kw. per month; all over 200 kw. at \$1.25 per kw. per month.

Energy Charge—50,000 kw.-hr. at 0.7c. per kw.-hr.; all over 50,000 kw.-hr. at 0.5c. per kw.-hr.

In both cases 234 tons of steel are melted, and at 550 kw.-hr. per ton, 128,700 kw.-hr. of electric power are used. In the first case the maximum demand is 900 kw., the demand charge \$1208.33, the energy charge \$743.50 and the total cost \$1951.83, which amounts to 1.52c. per kw.-hr. and \$8.35 per ton of steel melted. In the second case the maximum demand is 450 kw.-hr., the demand charge \$645.83, the energy charge \$743.50 and the total cost \$1388.83, which amounts to 1.08c. per kw.-hr. and \$5.93 per ton of steel melted. From this we see that by using the small furnace we save \$2.42 per ton of steel melted.

POWER FACTOR IS IMPORTANT

Electric power generating equipment and distributing lines are affected quite materially by the power factor of the power using equipment. Power factor is the ratio of the real power to the volt-amperes in an alternating current circuit. It is expressed in a per cent and is the number by which the volt-amperes must be multiplied to obtain the real power. Real power (P) in a three phase, alternating current circuit is expressed by the product of volts (E) \times amperes (I) \times the constant 1.73 \times power factor (PF), while volt-amperes are expressed simply by volts \times amperes \times 1.73, or P equals $1.73EI$ and PF equals $1.73PEI$. It is apparent, therefore, that for a given amount of real power supplied the current in the generating equipment and distributing lines varies inversely as the power factor. Real power is what is sold, but current is what determines the size of the generating and distributing equipment. If a given power load with unity, or 100 per cent, power factor requires generating and distributing equipment of a certain capacity, the same power load with 50 per cent power factor will require generating and distributing equipment of twice the capacity. The investment will increase accordingly, and naturally the fixed carrying charges will increase directly with the investment. In addition to the increased investment there are a number of operating and metering difficulties due to low power factor.

For these reasons power companies find it necessary to require the highest practicable power factor, and power contracts should therefore contain power factor clauses covering the manner in which power factor will

be treated in computing the cost of power under the stipulated rate. The latest types of electric steel furnaces can easily be operated at a power factor between 80 and 95 per cent, and it is very objectionable if a power factor of 75 per cent or lower is obtained.

In the generation of electric power in a steam plant, fuel constitutes one of the chief items of cost, amounting to something over 50 per cent. For a number of years the cost of fuel, particularly coal, has been fairly stationary and power rates have been based on the average cost from year to year, no special provision being made for appreciable increases or decreases. The marked increase in the past two years, however, of something over 100 per cent, brought about by war conditions, has shown the necessity of having a provision in power contracts that will vary the energy charge according to the cost and quality of coal used. Some power companies base their schedule rate on a given cost of 1,000,000 B.t.u. in coal delivered in the company's coal bunkers, and then add to or subtract from the energy charge a stipulated amount for each increase or decrease of 1c. in the cost of 1,000,000 B.t.u. This factor, sometimes called the "coal cost factor," takes care only of variations in coal cost; labor, the other principal item of cost involved, can be treated in a similar manner by using a stipulated base price per "man hour" for labor and varying the energy charge according to increases or decreases above or below that base price.

LONG-TERM POWER CONTRACTS IMPRACTICABLE

One thing is apparent, and that is that power companies cannot afford to make long-term power contracts at a fixed rate. Rate regulating bodies in the different states, of course, have authority to revise rates at any time and even though they are stated specifically in contracts, they may be changed. Revisions by these bodies, however, require appreciable expenditures of time and money in assembling data and preparing cases and often decisions are reached only after a prolonged delay. It is far better, therefore, that contracts cover probable necessary rate variations as fully as possible.

Load factor is a term referred to by power generating and distributing companies perhaps as often as any other term. It has a direct bearing on the cost of purchased electric power under a rate having a demand and an energy charge as discussed in a foregoing paragraph. It is the ratio of the average power load of a plant to the maximum load for a certain period of time. It is more specifically thought of as the ratio of the number of kilowatt-hours used by a plant in a month to the product of the maximum demand of the plant and the total number of hours in the month, which averages 730. Thus a plant having a maximum demand of 1000 kw. and using 365,000 kw.-hr. in a month has a "load factor" of $365,000 \div 1000 \times 730$, which equals .50, or 50 per cent.

The reason this term is so important to power companies is that the load factor of the generating plant has a very decided effect on the cost of generating and distributing electric power. Power generating and distributing equipment has to be of ample capacity to take care of the maximum load it is called upon to carry, so the investment is fixed by the maximum load, and consequently the annual fixed carrying charges covering interest, depreciation, taxes and insurance

are fixed. Further than this, power plants must be operated twenty-four hours every day and practical normal operating forces must be maintained regardless of the magnitude of the loads on plants and distributing systems. Labor costs, therefore, change but little whether loads exist for twenty-four hours or for but a few hours a day.

BENEFIT OF OPERATING DURING "OFF-PEAK" HOURS

Factories, office buildings and commercial and industrial establishments in general are normally in operation from eight to ten hours a day, starting from 7 to 8:30 o'clock in the morning and closing between 4:30 and 6 in the afternoon with from one-half to one hour shut-down at noon. In winter months the lighting load in offices and factories particularly is heaviest between 4:30 and 7 o'clock in the evening. If the generating plant also supplied power for operating street cars, which is usually the case in larger towns and cities, this load will be found heaviest at the time of the afternoon and evening lighting peak. It is a general condition, therefore, that the central station generating plants and distributing systems have to be equipped to take care of a relatively heavy peak load in the late afternoon, particularly of the winter months, and that for these peaks they have to maintain equipment which is idle at other times. It is at once apparent that a power load which is not used during the peak hours will not require additional generating capacity and corresponding investment and will not increase operating labor costs and consequently can be supplied at a lower rate than "on-peak" power. This kind of a load has attracted the attention of central station companies and most of them are glad to furnish off-peak power at a properly reduced demand charge and correspondingly reduced overall rate. Since electric steel furnaces can very easily be shut down during these peak load hours, furnace operating companies may benefit materially by considering this point when negotiating power contracts.

Similar consideration should also be given to night loads. In some cases furnaces may take care of the desired output by operating only at night, say between 7 p.m. and 7 a.m., and where this can be done a substantially low power rate may be obtained.

Disposition of Munitions

Mr. Benedict Crowell, Assistant Secretary of War and Director of Munitions, has been requested by the President to assume responsibility for the proper disposition of all property acquired by the War Department since April 6, 1917. Mr. Crowell has appointed Mr. C. W. Hare, Assistant Director of Munitions, to have general supervision of this work, and Brig. Gen. C. C. Jamieson has been appointed Director of Sales in direct charge of an organization to be perfected for the disposal of surplus property. It is the intention of the Director of Munitions so to market Government property as to interfere as little as possible with business conditions, and to this end the Assistant Director of Munitions and the Director of Sales will, as occasion may require, confer with committees representing the industries affected.

Information will be furnished by either the Assistant Director of Munitions or the Director of Sales at their offices in the Munitions Building, Nineteenth and B Streets, Washington, D. C.

Separation of Potash Salts

By H. P. BASSETT, PH. D.

IN CHEMICAL & METALLURGICAL ENGINEERING for the past few months much has been written on the potash outlook for this country. Many sources have been discussed, but the potash industry of this country, like the explosive and the allied chemical industries, will be compelled to undergo a decided change.

Potash derived from many of our present sources, such as wood ashes, Western lake brines, etc., will not be suitable for the market under the present system of production. Potash from such sources carries large amounts of other alkali salts, such as sodium carbonate, chloride, sulphate, borax and small amounts of the alkaline earth salts.

These crude salts are used today in our great emergency, but they are not suitable for many trades, especially the fertilizer trade, on account of their high content of other salts, particularly sodium carbonate, which, as is well known, reverts the phosphoric acid when added to acid phosphate fertilizer.

It is also claimed that borax in too large quantities has an over-stimulating effect on plant life. Some authorities, however, state small amounts are beneficial. These points, however, need much further investigation and during the meantime the trade will adhere to the old standards as closely as possible.

NATIONAL DUTY FOR CHEMISTS

It appears to the writer it is a national duty for the chemical profession to put our present sources in shape to meet the demand they will eventually meet in a peace-time basis. It would certainly be a calamity to let the present sources, such as the Western brines, go out of business on account of the necessary data on which to put them in a healthy condition.

The writer is speaking in general terms, but to illustrate the point more clearly a definite case will be pointed out. For instance, the Nebraska brines usually run about one-third potassium sulphate, one-third sodium sulphate and one-third sodium carbonate. This, however, is sometimes varied by a substantial percentage of sodium chloride. With this illustration before us, it is easily seen with the Nebraska location and the composition of these salts, if those constituents were separated each would have a market value and this field is within the freight radius of some of our best markets for salt cake and sodium carbonate. Of course, the potash would stand shipment even to the last want.

It is, however, different with the case of the brines further West, as these by-products have a very limited market on the West coast. But even in this case shipping high-grade potash salts they could demand the highest price and also save the probable cost of separation in the difference in freight rates.

The writer for several years was interested in the production of potash salts, especially from the silicate, such as feldspar, glauconite, etc., and during the investigation of this work was placed in a similar position as outlined above. That is, in order to make both ends meet, the products produced had necessarily to be separated economically.

With this in view the problem of separation was studied extensively and a number of important points were brought out which may be stated as follows:

1. It is almost impossible to separate a three ion system, for example potassium sulphate and sodium sulphate. This is either due to the formation of double salts or the salting out of one salt by the other on account of common ion. This may be overcome in this instance by the addition of common salt, which has two effects—it produces a four ion system and also tends to salt out the salt with a common ion, namely, sodium sulphate.

2. There is that tendency in any four ion system to form the greatest opposites possible. To illustrate this point, in the above system after the addition of the salt, the greatest opposite that could be formed is potassium chloride and sodium sulphate, consequently the potassium chloride remains in solution while the sodium sulphate is precipitated on evaporating the solution.

3. The presence of an alkali or a salt acting as an alkali tends to throw down the heavy acid salts as they exist in solution. To illustrate this point, if we have sodium carbonate or sodium acetate (a weak acid salt which acts as an alkali) the salts, potassium sulphate and sodium sulphate, will tend to be thrown down in the proportion they exist in solution, and this condition will be nearer and nearer approached on evaporating the solution on account of the increase in concentration of the alkali salt. Consequently in the case where we have an alkali present the heavy acid salts like potassium sulphate and sodium sulphate, potassium chloride and sodium chloride, will have to be thrown out of solution to free them from carbonate and then separated, adhering to the four ion system.

As to how these three so-called laws shall be operated depends on local conditions and original composition of the brines to be dealt with.

SOME LABORATORY RESULTS

It might not be out of place here to give some of my own laboratory results in a particular case I was dealing with at the time. In the case I had to deal with, the salts in solution were sodium sulphate, potassium sulphate and a small amount of sodium chloride, but, as you will see later, not enough to take care of all the potash.

The analysis of the solution was as follows:

Sp. Gr.	1.100
Total solids in 100 cc., grams	11.340
Total solids by weight, per cent.	10.490

Analysis of total solids:

Potassium sulphate, per cent.	9.19
Sodium sulphate, per cent.	78.35
Calcium sulphate, per cent.	0.56
Sodium chloride, per cent.	11.90

Of this stock solution 2000 cc., to which was added 20 gr. of salt, was evaporated until a quantity of salts was precipitated. These salts were washed three times on a funnel with hot water, weighed and analyzed with the following results:

FIRST SALT CROP

Weight, grams.	54
Sodium chloride, per cent.	0.57
Sodium sulphate, per cent.	99.29
Potassium sulphate, per cent.	0.14

The mother liquor which was wash waters and 1320 cc. more of stock solution to which was added 14 gr.

of salt was returned for further evaporation. Four salt crops were then taken out in succession, the weight and analysis as follows:

SECOND SALT CROP

Weight, grams.	98.50
Sodium chloride, per cent.	0.20
Sodium sulphate, per cent.	99.34
Potassium sulphate, per cent.	0.46

THIRD SALT CROP

Weight, grams.	73.40
Sodium chloride, per cent.	0.13
Sodium sulphate, per cent.	99.40
Potassium sulphate, per cent.	0.47

FOURTH SALT CROP

Weight, grams.	35.95
Sodium chloride, per cent.	2.08
Sodium sulphate, per cent.	89.60
Potassium sulphate, per cent.	8.32

After removing the fourth salt crop, 65 gr. of sodium nitrate were added, dissolved in as small a quantity of water as possible, the object being to convert the potash salts into potassium nitrate. This solution was now evaporated and a fifth salt crop taken, which was washed three times with hot water and which gave the following analysis:

FIFTH SALT CROP

Weight, grams.	39.20
Potassium sulphate, per cent.	0.43
Sodium chloride, per cent.	50.06
Sodium sulphate, per cent.	48.28
Sodium nitrate, per cent.	1.23

The mother liquor was then cooled to room temperature, when potassium nitrate separated out. This was washed three times with cold water and in analysis gave the following results:

Potassium nitrate, per cent.	92.96
Sodium chloride, per cent.	0.50
Sodium sulphate, per cent.	0.39
Sodium nitrate, per cent.	6.15

It will be seen that the first three salt crops are good marketable sodium sulphate. The other salt crop and also the mother liquor would be returned to the evaporator and recovered with a new lot of solution to be evaporated, the fifth salt crop furnishing the sodium chloride needed.

The above potassium nitrate can now be recrystallized to produce a pure product or converted into potassium sulphate, as outlined below. The potassium nitrate was converted to potassium sulphate by adding 12 gr. of sodium sulphate from first salt crop to 18 gr. of potassium nitrate. The solution was now evaporated and the potassium sulphate came down from hot solution above grade, analyzing 49.18 per cent K_2O , equivalent to 88.53 per cent K_2SO_4 .

The manufacture of sulphate by this process necessitates an extra step, but as none of the nitrate is lost in the operation, the cost will be in the operation.

The sodium nitrate solution can be returned to the point where the nitrate was added; thus the only additional evaporating cost will be in the evaporation of the water added in the dissolving of potassium nitrate and sodium sulphate.

It can be readily seen from the discussion set forth above that by this or some other method it is entirely feasible to produce our potash salts in a high grade form and also recover the other products in marketable form. It might be not out of place and also of interest to note in this connection that by the above procedure the writer has been able to produce ammonia nitrate from ammonia sulphate. In fact the three statements seem to hold for all alkali salts or sodium salts and if followed will, no doubt, form a basis for work much needed at present.

Distillation of Coal at Low Temperature*

THE distillation of coal at a high temperature, such as is actually practiced in gas retorts to extract illuminating gas, takes place under unfavorable conditions from a thermal point of view. According to results obtained by M. Euchène, only 12 per cent of the heat produced by combustion is available for distillation. M. Guéguen, relying on the fact that transmission of heat through the retorts is slight and that this transmission decreases in proportion to the distillation, set about to determine whether it would not be profitable to induce distillation by the introduction of a current of steam superheated to from 500 to 700 deg. His investigations showed several advantages: Shorter distillation periods, distillation accomplished more quickly and more directly, easier liberation of the gas by entrainment and operation at lower temperatures.

In addition, it was of great interest to know whether the coal itself could serve as a raw material for the manufacture of the aromatic compounds as well as for that of the hydro-aromatic and aliphatic compounds, obtained up to the present time from coal tar.

DISTILLATION IN A VACUUM

Moreover, attempts have long been made to obtain a better utilization of the coal either by distillation in a vacuum or by distillation at low temperature. Up to now, distillation in a vacuum, studied especially by Berthelot and Pictet, has had no practical application.

In distilling coal under a pressure of 20 mm. of mercury at a maximum temperature of 450 deg., Pictet has obtained 4 per cent of liquid coal tar, containing neither naphthalene nor anthracene, both of which are characteristic of coke-oven tar; however, in heating this tar red hot in incandescent tubes, it is transformed into ordinary tar. Pictet states that the tar obtained in a vacuum contains a greater quantity of phenol than crude petroleum and does not polarize light.

The distillation of coal at low temperature, on the contrary, will perhaps find an immediate and practical realization, thanks to the investigations instituted for this purpose at the special institute for the study of coal created at Mulheim on the Ruhr. (See *Génie Civil*, March 10, 1917, p. 165.)

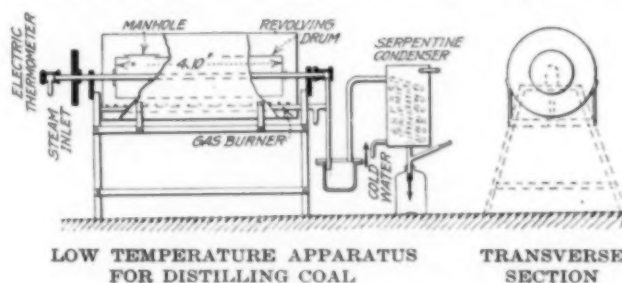
INVESTIGATING MINERAL OILS

This Research Institute, created by the Kaiser Wilhelm Society to contribute to the development of theoretical and applied sciences, has concerned itself particularly up to the present time with practical questions of immediate interest, notably, the investigation of mineral oils. We know that since the war Germany has lacked oils of all kinds. Lubricating oils which are now used are for the most part mineral oils extracted from petroleum and imported largely from America. It would be very advantageous then for Germany to be able to extract the lubricants which she needs from the coal by distillation.

The investigation of new sources of volatile products, of lubricants or of motor oils has led this institute to undertake a minute study of the chemical nature of coal and also of coal distillation at low temperatures.

This question is not new; already in 1906 Börnstein, of Berlin, published (*Journal für Gasbeleuchtung*, Aug. 4, 1906) results of a systematic investigation made by him on the distillation of coal at atmospheric pressure and at a temperature no higher than 450 deg. The coke used was friable and porous, and useless in metallurgy. It yielded a brown tar in a proportion of 3 per cent for the rich coals and 10 per cent for the flaming coals and those not containing free carbon. These tars, studied by Börnstein, were in reality paraffines melting between 55 and 60 deg. and containing up to 28 per cent acid products; the oily elements of the tars, freed of basic and acid compounds, contained neither naphthalene nor anthracene.

Below 350 deg. it contained no solid bodies; above 350 deg. paraffines were obtained; the benzols did not contain thiophene. The quantity of gas obtained was



small, 17.6 liters of gas per kilogram of flaming coal from the Bismarck mine yielding 10 per cent tar.

In England some companies were formed for the distillation of coal at low temperature, among others the Coalite Company, which obtained in place of coke some coalite or semi-coke (See *Génie Civil*, March 14, 1918, No. 20, p. 348) which can be used as smokeless fuel, but the tar yield was very large and the coalites too friable.

APPARATUS USED BY GERMAN INSTITUTE

In a conference on the actual state of the coal investigations held March 6 at the General Assembly of German Iron Masters and reproduced in *Stahl und Eisen*, April 12 and 19, Prof. Franz Fischer, director of the institute for the study of coal, discussed at great length the distillation of coal at low temperatures and described the apparatus used for this purpose by the German Institute.

This laboratory apparatus, represented in the illustration, is composed of an iron cylinder containing the combustible, heated by a gas flame and arranged to rotate slowly around on its axis (3.5 turns). With this arrangement, the particles of coal heated by direct contact with the walls cannot be overheated, for the layer in contact with the walls is constantly being replaced. Moreover, since the particles commencing to distil are brought back to the surface, the tar vapors do not encounter the layer of coal again, but are entrained and carried out of the drum by a current of steam introduced through the hollow shaft. An electric precision thermometer serves to show the temperature of the apparatus during the operation. The apparatus is completed by a deposit chamber and a coil immersed in water.

With this apparatus, complete distillation of coal is effected in one or two hours and there is obtained with rich coal 3 per cent tar, and with flaming coal 10 per

*Translated from *Le Génie Civil*, July 7, 1917.

cent tar, the composition of which is indicated in Table I.

M. Fischer says that by this method of distillation they obtained tars free from naphthalene and anthracene and containing paraffine. After the separation of the phenols, by distillation with superheated steam one can extract from the tar the lubricating oils forming 10 to 15 per cent of the weight of the coal and resembling those obtained in the treatment of coal by liquid SO_2 . These lubricants, red-gold in color and possessing a pleasing odor, are mixtures of oil. They have been able to extract lubricating oils from them which ignite at 200 deg. and have, at 50 deg. temperature, a viscosity of 2 deg. to 28 deg. (Engler). The oils set down in Table I as non-viscous are oils having the character of

TABLE I—COMPOSITION OF TARS EXTRACTED BY DISTILLATION OF COAL AT LOW TEMPERATURE

Composition, Per Cent	Tar from Rich Coal	Tar from Flaming Coal
Highly viscous oils (lubricants).....	15.2	10.0
Paraffines.....	0.4	1.0
Non-viscous oils.....	33.5	15.0
Phenols.....	14.0	50.0
Resin.....	4.2	1.0
Residual tar.....	19.2	6.0
Losses and water.....	13.5	17.0
Total.....	100.0	100.0

petrols and containing unsaturated hydrocarbons and true olefines of the formula C_nH_{2n} . They have been able to establish the fact that they polarize light weakly, which is quite characteristic of petrols.

GASES OF HIGH CALORIFIC VALUE

The gases obtained during the distillation have a very high calorific value, about 9000 calories, and have a volume of 40 liters per kilogram of rich coal and of 50 liters per kilogram of flaming coal. This high calorific value is due to the presence of 70 per cent methane, ethane and heavy hydrocarbons.

They have not been able to separate the light hydrocarbons from the gases of distillation by the ordinary method; to accomplish this, they have had to distil the gases by steam after compression of 20 atmospheres in the presence of paraffine oil. They have thus obtained aromatic carbons in an amount of 0.2 to 0.3 per cent of the weight of coal boiling between 20 deg. and 100 deg. and containing almost no benzol. These hydrocarbons are a mixture of volatiles the specific gravity of which at 20 deg. is about 0.65. They yield different kinds of petroleum derivatives in distilling, such as petroleum ether, ligroin, light and heavy benzines. The tar still contains very nearly as much of these benzines, or a total of 0.3 to 0.6 per cent of the weight of coal.

These bodies, the exact chemical nature of which is not yet known but the analysis of which shows 83.5 per cent carbon and 14.5 per cent hydrogen, are more hydrogenated than benzol (7.5 per cent) and its homologs.

From the experiments made up to this time one can conclude that, if the distillation at low temperature is carefully conducted, it is possible to extract from the coal all the industrial products of petrol: paraffines, lubricants, benzines, oils.

The economic success of this distillation at low temperature depends particularly on the utilization of the coke produced. This should be obtained adequately solid; if not producers should be set up near the dis-

tilling apparatus, so that the coke can be used while still warm.

Already, thanks to the labors of Messrs. Parr and Olin at the University of Illinois, it has been possible to improve the quality of the coke obtained by mixing finely pulverized coal with the coke dust and compressing the briquet of coal during the distillation.

Chrome Sands on the Pacific Coast

BY JUSTICE F. GRUGAN*

IN VIEW of the extensive reports published by the U. S. Geological Survey,¹ it is not surprising that interest has been revived in the black sand deposits of the Pacific Coast, especially during the recent period when war minerals, notably chromite and platinum, were urgently sought for the Government.

Occurrences of black sand are widespread. Not only are the beaches of California and Oregon rich in natural concentrations of black sands, but many inland water courses as well. A microscopic examination of samples of these sands from many different localities reveals a certain uniformity of species and physical condition of the component mineral particles. Their proportion, however, varies to a marked degree. This variation is explained by the different conditions in the original formations from which these black sands were derived. Chromite is known to have its origin in magmatic segregation during the formative period of the peridotites and serpentines. Its subsequent liberation by erosion and decomposition, its transportation by water and the final localization of the heavier grains are processes whose occurrence is amply verified by the testimony of geological formations and the beach and river sands.

During an examination begun in June, 1918, of beaches and ancient marine deposits lying between Crescent City, California, and Bandon, Oregon (a distance of approximately 125 miles), frequent panning and magnetic tests showed that the proportions of chromite and platinum increased appreciably as the investigation proceeded northward.

HISTORICAL NOTES

Fifty or sixty years ago the pioneer placer miners discovered a stratum of black sand, rich in gold values, located in the vicinity of Cut Creek, two miles back from the beach and about six miles north of what is now the City of Bandon in Coos County, Oregon. Tales of wild but prosperous communities in the old Randolph mining district are confirmed by a few desolate ruins of log cabins, partly buried by the encroaching drifts of sand. Many evidences are seen of futile attempts to win fortunes from these elusive sands. In one place, half buried, lies a complete drag bucket equipment, rusty and rotten; close by stands a large concentrating mill with strange types of zigzag rifles, screens, trommels and assay furnaces.

One beach relic of striking outline consists of a huge automobile dredge and concentrator. Great drumlike wheels of steel plate support an intricate superstructure, which houses an engine, a boiler, sluice and bump-

*Engineer, Suffern Co., N. Y.

¹David T. Day and R. H. Richards in Mineral Resources of the U. S., 1905.

ing boxes and finally a ponderous bucket excavator driven by massive pinions, gears and sprockets. A single trial of this \$20,000 machine showed that it could nose in successfully, but was unable to withdraw from the cavity so created. It should be mentioned, however, that these failures or so-called "monuments" resulted from many attempts to extract gold and platinum from the beach sands. The idea of treating ancient marine sands or "back beaches" primarily for chrome values is the outcome of war-time necessity and largely dependent upon consequent prices for success.

ORIGIN OF CUT CREEK CHROME SANDS

The Old Lane Mine, on the south branch of Cut Creek, was operated in the early days chiefly by underground methods and by the removal of light sand overburden. In thickness the deposit averaged six feet and underlaid several acres of ground at depths of from ten to thirty feet. The formation is probably of comparatively recent origin, as trunks of trees were sometimes encountered in the workings and displaced only with considerable difficulty and expense. The black sand was mined by pick and shovel and dumped into sluice boxes. Various devices were used to collect the gold and heavier "white metal" platinum, which, it may be stated in passing, was much despised, as it reduced the selling value of the gold, and if sold separately brought only 50c. an ounce. The rejected black sands were washed down Cut Creek and allowed to settle in a low swamp termed the "Lagoon."

The area of the "Lagoon" covered by these tailings is 2200 feet in length and from 30 feet at its narrowest limits to 220 feet at its greatest width. The surface measurement is approximately 5.8 acres, and the deposit is from one to eight feet deep. Where the soil has mixed with the sand to a depth of several inches it is covered by vegetation and a few small trees.

CHARACTER OF THE "LAGOON" SANDS

The observer is impressed with two characteristics in studying this particular deposit. First, the average fineness of the individual grains, about 93 per cent of which will pass through a 40-mesh screen. Second, the variety of mineral constituents, chief among which, in the order of their proportionate amounts, are:

Mineral	Proportionate Per Cent.
Chromite.....	45
Garnet.....	30
Quartz and other silicates.....	20
Magnetite and ilmenite.....	3
Zircon and monazite.....	2
	100

This composition is not typical of Pacific Coast black sands. The percentage of chromite is unusually high and differs widely from similar appearing sands of the southern beaches which frequently contain over 50 per cent of magnetite. The individual particles are very fine and rounded but the deposit contains no slimes. The material weighs from 109 to 159 lb. per cubic foot, depending upon the variation in metallic constituents.

TONNAGE AND ANALYSES

The "Lagoon" has been carefully prospected by a series of pits at 50 foot intervals, sunk along forty-five parallel lines. A total quantity of 25,000 tons has

been calculated, which averages 22.536 per cent chromic oxide, Cr_2O_3 . Remarkable uniformity is shown in the results here presented:

Line	Per Cent.	Line	Per Cent.
1 Cr_2O_3	24.05	23 Cr_2O_3	24.05
2 Cr_2O_3	24.05	24 Cr_2O_3	24.06
3 Cr_2O_3	22.2	25 Cr_2O_3	24.5
4 Cr_2O_3	23.05	26 Cr_2O_3	21.8
5 Cr_2O_3	21.8	27 Cr_2O_3	23.0
6 Cr_2O_3	22.2	28 Cr_2O_3	18.6
7 Cr_2O_3	20.5	29 Cr_2O_3	21.8
8 Cr_2O_3	21.4	30 Cr_2O_3	19.5
9 Cr_2O_3	26.5	31 Cr_2O_3	14.1
10 Cr_2O_3	23.05	32 Cr_2O_3	20.4
11 Cr_2O_3	24.1	33 Cr_2O_3	21.8
12 Cr_2O_3	23.9	34 Cr_2O_3	21.8
13 Cr_2O_3	23.8	35 Cr_2O_3	23.8
14 Cr_2O_3	24.1	36 Cr_2O_3	19.5
15 Cr_2O_3	23.6	37 Cr_2O_3	22.6
16 Cr_2O_3	22.8	38 Cr_2O_3	23.1
17 Cr_2O_3	22.5	39 Cr_2O_3	24.05
18 Cr_2O_3	24.05	40 Cr_2O_3	22.5
19 Cr_2O_3	16.02	41 Cr_2O_3	22.1
20 Cr_2O_3	20.9	42 Cr_2O_3	26.0
21 Cr_2O_3	22.0	43 Cr_2O_3	23.0
22 Cr_2O_3	24.5	44 Cr_2O_3	21.1
		45 Cr_2O_3	29.8

METALLURGICAL TESTS

Test runs on representative samples of these sands have been made at San Francisco, Denver and Seattle. A comparison of results indicates a recovery of from 70 to 75 per cent of the Cr_2O_3 contained in the original sands, in the form of a chromite concentrate averaging 40.45 per cent Cr_2O_3 .

The San Francisco test was a table concentration at the laboratory of Hamilton, Beauchamp and Woodworth; Electromagnetic concentration at laboratory of University of California, Berkeley, California.

The sample was screened through a 40-mesh screen, the oversize being rejected. The material which passed through this screen was run on a Deister-Overstrom table, making two products—a tailing, which was rejected, and a rough concentrate. This rough concentrate was retailed, producing a middling and a finished table concentrate. The middling product was reserved for further treatment. The finished table concentrate was dried and run over a Wetherill magnetic separator, producing the final products of this test.

The Denver test was at the testing laboratory of Henry E. Wood.

The sample was screened through a 20-mesh screen, the oversize being rejected. The undersize was further screened through a 40-mesh screen, the oversize from this being likewise rejected. The 40-mesh material was run on a Wilfley table producing a tailing product, which was rejected, and a concentrate which was further treated on a Wetherill electro-magnetic separator.

The products from poles 1 and 2 were mixed to form the magnetite product, and 3 and 4 to form the garnet product. Pole 5 produced the chromite concentrate which analyzed as follows:

	Per Cent.
Cr_2O_3	41.35
SiO_2	4.10
Al_2O_3	13.05
FeO	24.58
Mn.....	1.64
Sulphur.....	0.81
TiO_2	Trace

Pole 6 gave a product consisting of a yellow sand (monazite) and chromite. The non-magnetic reject was further treated on a Wilfley table, producing thereby a tailing which was rejected and a concentrate consisting of zircon. Recovery of the chromite was shown to be 77.44 per cent.

The Seattle test was at the Laboratory of the U. S. Bureau of Mines experiment station.

The material was run over a half-size Deister-Overstrom concentrating table, forming three products--concentrate, middling and tailing. The concentrate and middling were run separately over Dings magnetic separators, forming in each case concentrate, middling, magnetite and sand products. The respective products from the two separations were of approximately the same grades, so were brought together, forming the final products of chromite, concentrate, middling, magnetite and sand. To this last (sand) was added the tailing product from the Deister-Overstrom table separation.

PROPOSED METHOD OF TREATMENT

Based on the results of the foregoing tests, it is planned first to screen the sands and reject the 40-mesh oversize. The undersize will be concentrated on Deister-Overstrom tables, dried and then passed over a 3-magnet, six-pole Wetherill magnetic separator. The non-magnetic reject from the separator may be re-tabled and the zircon recovered.

Rejection of the 40-mesh oversize will, at the very beginning of the treatment, throw out about 8 per cent of the sands, without loss of valuable contents. Treatment on the Deister-Overstrom tables will further reduce the amount of material for magnetic separation. The concentrate leaving the table will be approximately 75 per cent, by weight, of the original sands and will contain 95 per cent of the chromite. The Wetherill magnetic separator treating the concentrate will recover over 75 per cent of the chromite. These chromite concentrates have been tested by the Huff Electrostatic Separator Co., and preliminary reports show that the grade can be improved to 46 per cent Cr_2O_3 , or better.

The other products from the Wetherill separator will be magnetite, garnet and zircon (in the tailings).

PRODUCTION

Since the total tonnage in the "Lagoon" is 25,000 tons, and a conservative estimate of the average Cr_2O_3 content is 20 per cent, a total of 5000 tons of Cr_2O_3 is obtained. Allowing 15 per cent loss in mining leaves 4250 tons and assuming a recovery of 70 per cent in milling, the amount is reduced to 2975 tons of Cr_2O_3 . This is equivalent to 7437 tons of chromite concentrates averaging 40 per cent Cr_2O_3 . There will also be about 4800 tons of garnet, 460 tons of magnetite and 238 tons of zircon produced. These chromite concentrates are particularly suited to the chemical trade, although the tenor of chromic oxide is not as high as in the imported ores. The rate of production should be from 300 tons to 400 tons monthly.

UNSTABLE CONDITIONS DELAY OPERATIONS

Operations have been delayed owing to the unstable conditions affecting the chrome ore market. The lessee received direct encouragement from Government bureaus until very recently, when all support was withdrawn and the problem of finding a market for the product became the most important factor in the enterprise. Apparently the Government admits its moral obligation to protect domestic chrome ore producers who are left "holding the bag," but as yet no constructive action or policy is forthcoming.

Canadian Graphite Industry

HUGH S. SPENCE presents a short paper on "Canadian Graphite" in the recently issued Summary Report of the Mines Branch of the Canadian Department of Mines, 1917. He notes that the producing deposits occur in the Provinces of Ontario and Quebec within a radius of 150 miles of Ottawa. In spite of the great demand, but three companies operated at all steadily; nine others, each equipped with a mill, have been completely idle or in only intermittent operation.

The flake graphite occurs in disseminated form either in crystalline limestone or in calcareous bands intercalated in gneiss. Both varieties of ore have been treated by essentially similar concentration methods. These are, briefly, drying in wood-fired kilns, reducing in gyratory crushers followed by two or more sets of heavy rolls, and subsequent alternate screening and crushing in rolls of the flour-mill type. Each set of rolls eliminates gangue by reducing the brittle calcite and silicates to powder, while the soft graphite tends to flatten out and is caught by the screens. The product from the final set of rolls is sometimes polished between burr-stones or goes to an electrostatic machine, which removes any remaining impurities, particularly mica; the latter is one of the most difficult minerals to eliminate, owing to its softness and consequent resistance to crushing.

In the early days of the graphite industry, a wet process of concentration, employing buddles, was practiced. This method is still in use at one mill, as the initial step in concentration, followed by drying, the dried product then proceeding to rolls and screens.

While certain of the mills achieve a fair recovery of the graphite contained in the ore treated, the majority lose an undue percentage in the tailings. The concentration methods in general use are far from being efficient. In addition to poor recovery, the carbon content of the best, or No. 1, product is seldom brought over 90 per cent, and is generally lower; a great deal of the flake in the rock is broken up in the milling, and goes into the finer No. 2 product and to the No. 3, or dust. The large amount of dust produced in the mill in grinding the kiln-dried ore is very objectionable. Screen tests on samples of No. 1 flake from seven mills showed the mean percentages of different size flake composing this grade to be as follows:

	Per Cent
+ 20 mesh	1.7
+ 40 mesh	18.5
+ 60 mesh	67.6
+ 80 mesh	8.0
+ 100 mesh	1.1
- 100 mesh	2.9

Most mills produce three grades of graphite, known as No. 1 flake, No. 2 flake and dust. The No. 1 flake goes principally to the crucible trade; No. 2 is employed in lubricating products; and No. 3, or dust, is used in foundry work.

The graphite particles employed in crucible manufacture are required to be of a certain size in order to bind efficiently with the clay. In this connection it may be noted that one of the reasons for the preference for Ceylon graphite for use in the manufacture of crucibles is that this variety does not occur in thin flakes like the American graphite, but is more massively crystalline and breaks up on crushing into more angular fragments, hence it requires less clay as a binder.

Minor Occurrences of Mercury in Europe

Comments on the Minor Quicksilver Operations in Austria, Italy, Spain and Mediterranean Countries—
Mercurial Poisoning Cases Are Numerous, Due to a General Lack of Sanitary Precautions—
Hygienic Measures Being Introduced at Idria

BY DR. ROLAND STERNER-RAINER¹

IN ADDITION to the great mines at Almaden, Spain also possesses productive quicksilver deposits in the Asturian province of Oviedo, in Bajodez (Estremadura) and Granada (Andalusia), while the many others, even those of La Creu, have no commercial importance. To complete the list of mercury deposits the following must be mentioned, even though they are only of geological or mineralogical interest: Andra (Santander), in Teruel, Gargantiel (Ciudad Real) Torbiscon (Granada), Cartagena (Murcia), as also Purchena and Cuevas de Vera (Almeria).

Mieres, the center of the Asturian mining industry, (the quicksilver mines of the "Union Asturiana" and "El Provenir" or "Pena y Esperanza de Mieres" are situated here) lies on the railroad from Oviedo to Leon. These deposits, which at present are exploited in 24 mines, were worked by the Romans, but have been re-opened only since 1840. The ores are impregnations of cinnabar with a little metacinnabar, amalgam, orpiment and realgar, in the carboniferous breccias and quartzites.

The output, which in 1911 was 4699 tons of ore having an average content of 0.7 per cent, is treated in seven retorts, seven "Gascue-Rodriguez" furnaces, and four of the old type of Idrian furnaces. Fifteen tons of mercury (formerly 50 to 80 tons) were produced. The impregnations found along this same railroad south of the Cordillera Cantabrica at Pola de Lena and Limares, and at the Rio Muno, are not of commercial importance.

The ores of Usagre Bienvenida in Bajadoz province (on the railroad from Merida via Zafra to Sevilla) are richer than those of Mieres. Here the cinnabar is associated with sulphide of copper ores, spathic iron and manganous carbonate, in quartz veins in the crystalline limestones of the Cambrian. This limestone also shows occasional cinnabar impregnations. Despite the fact that these deposits have been opened only a few years and that one of the new mines has doubled its former production of 1000 tons of ore per annum so that the future operation of these mines seems sure, two new Bustamente furnaces may be admired in full operation. The ore content, formerly 1.24 per cent, has increased, this fact explaining the relatively high output of 40 tons of mercury. Ores from the "Alpujarra," on the south slope of the Sierra Nevada, show a content of 0.7 to 2 per cent mercury. The mercury is contained in iron oxide incrustations of calcite; in certain places this oxide is so plentiful that two Bustamente furnaces were erected to treat it. In Valencia, all ef-

forts to treat the ore profitably have failed; this ore consists of an intimate mixture of cinnabar, quartz and carbonate as vein fillings in the sandstone.

Even Portugal, which possesses no deposits of note, has produced small quantities of mercury during the last few years. The unexpected increase in production of the mines on the Appenine peninsula is due solely to the mines of Southern Toscana, at Siena Grosseto. The operations at Vallata, in the Province Belluno, have been abandoned for four years, while those of Levigliani and Ripa, in the Province Lucca, and those of Jano have been abandoned for 50 years.

Practically all the Italian production is from the region near Monte Amiata, and the operations of the live properties have been already described². The mercury occurrences at Arcaja (Lucca), Monte delle Fate (Pisa), Monte Loreto (Genova), San Quirico di Albaceto (Parma), Margna (Como) and San Donata (Cosenza) are of interest mineralogically, but are not exploited. The fine dust of lead smelter at Monteponi, Sardinia, yields a few hundred kilograms per annum.

SMALL AUSTRIAN AND HUNGARIAN DEPOSITS

Austria possesses an even greater number of quicksilver occurrences than Italy, but here also the metal is found in quantity only at one locality. Idria, alone, is responsible for the country's production, all other mines being closed or never having been worked for cinnabar ores alone. Twenty years ago the plant of Littai in Krain was abandoned, which only shortly before had been producing 20 metric tons of mercury, and ten years later the neighboring plant of St. Anna, which was a rival of Littai in the '90s, followed suit. Sagron, in southeast Tyrol, which was exploiting the same ore body as the Italian Vallalta Company, has abandoned its mine and reduction plant since 1907. The best of the Dellach mines—Reichenau and Kotschna—as also that of the Buchholz mines near Paternion, have been abandoned for 60 or 70 years.

Since the decline of Russia's production³ the only other European country producing quicksilver was Hungary, which produced about 80 tons. There are quite a number of quicksilver occurrences in Hungary, but at present the entire production comes from the Kotterbach plant in upper Hungary, where fahl ores are being treated. The Kotterbach mines also carry spathic and brown iron ore, through which small amounts of fahl ore are disseminated. The fumes formed in calcining these brown iron ores are passed into the bottom of limestone-filled, water-sprayed, wood condensers. Mercury, arsenic and antimony compounds and ore dust

¹Osterreichische Zeitschrift, für Berg- und Hüttenwesen, Vol. 62, 1914, p. 529. Translated in connection with a co-operative investigation of the metallurgy of mercury being carried on by the United States Bureau of Mines and the New Idria Quicksilver Mining Company. C. N. Schuette, Metallurgical Assistant, Bureau of Mines, Translator.

²Eng. and Min. Journ., 1889, Vol. 48, No. 20; 1898, Vol. 62, No. 7; Rev. Univers. de Mines, 1896, 32, 233; Mineral Industry 4, 524.

³Chemical and Metallurgical Engineering, Vol. 19, p. 770.

⁴Since new ore bodies have been found in Nikitowka, the plant is being rebuilt.

are condensed to a slime carrying about 25 to 30 per cent mercury. This slime is filtered through coke, is washed and dried, and together with fahl ore, constitutes a charge containing 1.5 to 2 per cent mercury for two fine-ore furnaces. The rich soot of the furnace flues is pressed in the same manner as the furnace soot caught in the Cermak condensers, and the soot rejects are again charged to the fine-ore furnaces.

The quicksilver mine of Zalatzna in Siebenbürgen is no longer productive, and the entire production of Hungary amounts to only 80 tons of mercury per annum.

There are several quicksilver prospects in Bosnia. Bosnic-Idria and Maschkara, however, are the only two that have produced any quicksilver (by a process resembling medieval metallurgy). To-day the developed ore bodies of these mines have been worked out. The promising quicksilver prospect of Avala which was discovered while grading for a railroad at a point about 25 km. south of Belgrade has also been worked out.

DEPOSITS IN OTHER MEDITERRANEAN COUNTRIES

Since none of the other European countries produce quicksilver—Prussia produces a few tons per annum from fine dust and lead chamber slime—there remain only the Mediterranean countries Algeria and Asia Minor to speak about. Even though these countries do not belong to Europe, they are closely related to it, both in historical development and economic relations. The Taghit mine, situated about 35 km. from the Algerian city of Batna, was one of the first to erect Cermak-Spirek fine-ore furnaces to treat their mixed ore, zinc blende and argentiferous galena containing cinnabar. Spirek also modified the coarse-ore shaft furnaces and the lead-treating reverberatory furnaces, so that they serve not only to roast the ores, but are at the same time adapted to the recovery of mercury.

Noticeable competition may soon be expected from the young mines of Asia Minor. The Anatolian ores found in a dry, high country not far from Koniah* were worked by the ancient Phrygians more than 3000 years ago. The knowledge of these prospects was lost in later times until the cinnabar was re-discovered by the chance find of a shepherd boy.

The ores are associated with local silicifications in the limestone, these silicifications being of contemporaneous deposition with the cinnabar. More than 13,000 tons of 1 per cent ore had been developed in these mines as long as five years ago. To furnace these ores the 15-ton Spirek shaft furnace and an 8-ton fine-ore furnace were erected.

Near the coast at Kara Burnu, about 30 km. south of Smyrna, large bodies of cinnabar-impregnated quartzites are found so near the surface that they can easily be mined by surface methods. The average ore mined during the first year of active mining operations ran 0.75 to 1 per cent mercury. The metallurgical plant consists of two Spirek shaft furnaces for lump ore and one fine-ore furnace. The capacity of the plant is 40 tons of ore per day, and the monthly production was 250 to 275 flasks of mercury.

One question always asked when quicksilver mining is mentioned is: "What influence does the reduction

of mercury ores, the frequent contact with metallic mercury and the inhalation of the fumes of this metal exercise upon the human organism? What influence has this effect on the health of the workmen engaged in producing this metal, and to what degree has it been possible to eliminate or counteract these detrimental effects by improving the metallurgical practice and by social welfare work?"

The extensive literature on the subject of mercurial poisoning^a shows that the symptoms of this poisoning are a swelling of the gums, a reddening and infection of the mucous membrane and the throat, excessive saliva flow and disorder of the digestive organs. Together with these ailments, the sick person experiences a dull feeling and exhibits a peculiar timidity which prevents him from working quietly while being watched. If the work around a quicksilver plant is not given up the infection of the mucous membrane develops ulcers in the mouth and causes a swelling of the saliva and lymphatic glands. The muscular control is also affected, resulting in a curious shaking of the body called tremor mercurialis, which may become so severe that those affected die from the fatigue it causes. The human organism when weakened from this disease is very apt to contract tuberculosis.

MERCURIAL POISONING FREQUENT AT ALMADEN

As might be surmised from the description of the conditions at Almaden, the cases of mercurial poisoning at this plant are very numerous. Not only the men in the reduction plant are exposed to this poisoning but also the miners in the poorly ventilated mines; this mercury vapor in the mines is due to the plentiful sprinkling of metallic mercury in the ore. If the number of fatalities at the plant is not large, this is because it is closed for about six months, in which time the workmen have opportunity partially to regain their health in the clear air of this elevated region. Even though the workmen three years ago appealed to the Government for a betterment of the hygienic conditions at the plant, and though professional men affirmed the itemized evils, little has been changed.^b

The number of patients is still very great; even serious cases, such as "calambres," tremor, paralysis and ulcers which attack first the gums and then the jawbone are not rare. Wash bowls and baths are unknown at the plant. As noted, the miners are no less subject to mercurial poisoning than the reduction plant men, even though the latter are furnished with clothes made of a smooth material which are cleaned on company account. This is the sum total of the social welfare work, as there are no competent laws for the protection of workingmen and there is no inspector looking after the execution of such laws.

TUSCANIAN CONDITIONS BETTER

The hygienic conditions in the Tuscanian works are very much better. The ore of the entire district contains no trace of free mercury, so that mercurial poisoning is not possible in the mining and drying of the ores.

*F. F. Sharpless, *Eng. and Min. Journ.*, LXXXVI, 1908, September, p. 601; *The Mining Industry*, 1908, Vol. XVII, p. 746; *Rassegna Mineraria*, 1908, April 11.

^aA. Kussmaul, *Untersuchungen über den konstitutionellen Merkurialismus und sein Verhältnis zur konstitutionellen Syphilis*, Würzburg, 1861; Letuelle, *Essai sur l'hydrargyrie professionnelle*, *Revue d'hygiène* 1859; Ludwig Teleky, *Die gewerbliche Quecksilbervergiftung*, Berlin, 1912.

^bR. Velaz and José de Udeba: *Informe sobre las minas de Almaden*.

The individual plants are generally smaller, and because of the mild Italian climate, are airily built, assuring a frequent change of atmosphere in the buildings. The Abbadia San Salvatore plant, which was built only last year, incorporated hygienic principles in its construction and has numerous provisions for safeguarding the health of its workmen, only 25 per cent of whom are exposed to fume. Even so, as has been stated by C. D. Castro, not only are those exposed workmen subject to this occupational disease, but in time even those men who only handle the metallic mercury become sick. Careful instruction of the furnacemen would, no doubt, eliminate one source of the mercurial poisoning, but despite the most careful supervision by competent foremen, it was impossible to eliminate the carelessness of the workingmen. The clean-up, the treatment of the soot and the bottling of the mercury will always be dangerous as long as the present method of manipulation obtains, and the danger can only be minimized by the exercise of great caution on the part of all concerned.

Respirators which Tarngi¹ constructed of thin layers of aluminium netting were not successful at Abbadia San Salvatore, as this metal easily forms an amalgam with incidental tumefaction and development of heat. Frequent interchange of the men between the mines, reduction plant and outside working places is a beneficial, but not strictly adhered to, policy. Suitable working clothes, hot baths and frequent medical examinations, which are compulsory at Abbadia San Salvatore, prevent the development of serious cases of mercurial poisoning, and the occupational disease statistics of the plant are very encouraging since 1910.

WORK IN IDRIAN MINES NOT DANGEROUS

The work in the Idrian mines, in which metallic mercury is found along with cinnabar, is not dangerous, as shown by statistics. The policy of changing the men who work in the stopes is strictly adhered to and adequate ventilation is obtained by improved methods. Light cases of sickness still occur, because the sense of cleanliness is but little developed in the workmen, and they do not make sufficient use of the bathing facilities provided at the plant. The change of workmen in the reduction plant, which has been reintroduced since 1897, has also bettered the conditions of health. Since the beginning of this century the amount of sickness has been further reduced by the technical improvements of the plant, and is now at the lowest known figure. Each workman is furnished with large rations of fat (as the eating of fat is thought to be beneficial), is furnished with suitable working clothes and enjoys an annual vacation of two weeks at full pay.

Light cases of poisoning are easily cured by a longer stay in a region of pure air. The introduction of producer-gas furnaces is a further step toward the fulfillment of hygienic requirements, as the soot production is less and consequently the work of the clean-up and of the soot treatment could be reduced appreciably. Kroupa's new shaft furnace will be a further step in this direction, as will the mechanical disposal of the furnace tailings, the improved condensers, the covered soot presses and the proposed new stack, all of which combine economical with hygienic advantages, and assure to Idria its position as the model quicksilver plant.

Lately bathing facilities have been provided at the reduction plant also, and if occasional cases of sickness still occur, this will not be the fault of the health regulations of the plant, but will be due to the lack of good will on part of the workmen who carry out their assigned tasks without the proper sense of responsibility, neglect to use the shower baths, do not change their clothes, and by living in closed hot rooms allow the mercury of their clothes to vaporize. No amount of technical improvements or health regulations can change this; only a competent education of the workmen and their families for a period of many years can effect a complete remedy.

Engineering Research in Chemical Organizations

BY CROSBY FIELD

DURING the past four years the chemical industry in this country has been very rapidly advancing, having met with little opposition, but now, with the return of peace conditions, there is apparent the necessity for reorganizing to meet extremely intense competition, or as it may be called, "consolidating the positions in order to withstand heavy counter-attacks."

The parts to be played in this readjustment by finance, trade, commerce, export and other similar functions have been frequently discussed, and it is believed are now quite well understood, hence will not be mentioned further herein. There is one very useful "arm of the service," however, that it is believed is not quite so well understood, and it is the purpose of this article to invite attention to its activities and importance. For want of a more precise title, this function may be called "Engineering Research."

In any chemical organization there should be, of course, one research department, under the head of one man, who will be termed for the purpose of this article the manager of the research department. This department is divided into two branches, chemical and engineering, each under one man, who for the purpose of this article will be called a director; so that there should be a director of chemical research and a director of engineering research.

The functions of the director of chemical research are so well understood by the members of the chemical industry that further mention may be omitted and the remainder of this space devoted to a brief summary of the functions of the director of engineering research.

The director of engineering research has five principal functions to perform, which may be modified according to the particular organization in mind. These are (1) experimental, (2) compilation of engineering data, (3) standardization of layout and apparatus, (4) education and (5) liaison.

The experimental work necessary arises from two different causes, which, however, are interlocking, hence usually the same work produces both classes of results desired. These classes are the adaptation of chemical processes to factory conditions and the development of special chemical machinery.

The chemist usually develops his process in the chemical laboratory, using grams of chemicals in glass apparatus, dealing only superficially with the physical characteristics of the intermediates and of the final

¹Gazz. chim. Ital. 34, II, p. 436.

product and neglecting all matters concerning the quantities of energy required and the best method of transmission thereof. The process is then put into the factory using hundreds or even thousands of pounds instead of grams and metal or wooden apparatus instead of glass, when the physical characteristics of the products and of their containers become vital, the impurities collected in the process assume greater importance, and the economy of the process frequently depends upon the method of supply and transmission of the energy required. It is because of such conditions that processes seemingly good in the laboratory fail in the factory; and conversely, processes which appear good in the laboratory, but which involve many questions to which the factory answers are not known, fail to be tried out in the factory because of the heavy expense at stake.

The general answer to the above situation is a function of the director of engineering research, and to accomplish his object he has an engineering or factory laboratory. This is a building equipped with small apparatus similar in all respects to the apparatus which is standard in the factory and of such size as to give accurately the necessary physical constants. This will generally be found to require units having a capacity of several gallons, or about one hundred pounds. The interior of the building will generally be without permanent structures, with the exception of a number of columns, to which beams may be quickly clamped, so as to facilitate the setting up and the tearing down of apparatus.

WILL ADAPT CHEMICAL PROCESS TO THE LABORATORY

Within this laboratory will be accomplished the adaptation of the chemical process to the factory. The chemist will turn over the complete results of his experiments with grams of material within glass tubes to the director of engineering research, who in this laboratory will determine the proper apparatus to be used, and in connection with the director of manufacturing, the approximate sizes thereof. He will be responsible for deciding the material of which the apparatus shall be made, whether direct fire, steam or oil will be used for heating, the utilization of waste gases, limits of and methods of engineering control, etc. In some organizations he will be responsible for designing the plant, but if not he is to turn over to the design engineer the necessary data and the proper recommendations for types of apparatus.

In order to accomplish the above it is necessary that he perform well his second function, that of collection of engineering data. To do this he may either utilize the factory organizations or send agents to run special tests, or both. He must have available, however, not only the basic facts regarding each type of machinery present in the plant or advertised on the market, but also operating records of cost, including maintenance and consumption of power, in so far as possible. This should apply not only to the process apparatus in the plant, that is to say, what is more generally called the chemical machinery, but also the plant machinery, by which is meant all that directly connected with the power plant, including boilers, engines, refrigerators, gas producers, compressors and vacuum pumps, pumps, elevators and conveying machinery, etc. Having col-

lected these data, the third function, that of standardization of machinery, follows as a matter of course.

In all these three functionings situations will arise which indicate the necessity or desirability of a new type of special chemical machinery, which should then be developed in the engineering laboratory. It is thought that this will become very important in the near future, as a stabilizing of the chemical industry throughout the world will tend to establish standard chemical processes, after the establishment of which manufacturing success will depend in greater degree upon the development and adoption of special machinery.

FUNCTION OF EDUCATION FREQUENTLY OVERLOOKED

The fourth function, education, is a matter frequently overlooked. The training of the necessary personnel for a new industry is always hard, but is vital to the success of that industry. It is essential that it be recognized as a necessary function, and its place included in the several branches of the organization where opportunity is afforded for its performance.

The director of engineering research should, therefore, publish to a selected list of trustworthy employees such of his accumulated data as would appear desirable. This can well be done by means of a mimeographed periodical, which should be kept up to the minute by containing the results of the latest tests, especially acceptance tests on new installations. He should also provide for lectures and the other well-recognized methods of disseminating information, but by far his greatest opportunity lies in his laboratory during the time that a chemical process is being adapted to the factory. The operating foreman-to-be and his principal assistants should be present during the experiments, and this small unit production should be continued for a while under the actual operation of these men, directed by the engineering laboratory specialist in charge.

The fifth function, liaison, is the most difficult to perform satisfactorily, and will be the one, in the last analysis, which will cause the director to succeed or to fail. Close touch must be had with all departments and with all plants, and this contact must be maintained in spite of the many pet theories and frequently crotchety characters of the various executives and men concerned. The director must so limit his activities to the strictly engineering and advisory sides that in his dealings with the chemist, particularly while the process is still in the chemical laboratory, the latter will have no suspicion of his motives and will render him full information and his further co-operation during the period the process is in the engineering laboratory. Many good suggestions will be forthcoming from men in the plants, and a system should be arranged for giving recognition to the individual.

In short, there is present to-day in each chemical company of any considerable size the necessity for a director of engineering research, who must perform his major functions of engineering experiments, compilation of engineering data, standardization of layout and apparatus, education and liaison with energy and tact. He should, furthermore, be a man of considerable executive ability, engineering experience and knowledge of chemistry, and should, moreover, have linked with those no small degree of inventive talent.

Recent Chemical and Metallurgical Patents

Alumina for Refractories and Abrasives

Crystalline Fused Alumina.—F. J. TONE of Niagara Falls patents a process of treating ores of alumina containing alkali, such as alunite, so as to recover the alumina in fused crystalline form and the alkali in water-soluble compounds. He charges the ore into an electric arc furnace of the depending electrode type, such as he patented in No. 929,517, and heats it to a temperature in excess of 2100 deg. C. This drives off all the moisture, sulphur and potassium of the alunite without forming any double silicates of potassium and aluminium which result from low-temperature calcination. The fume may be caught in well-known apparatus. The crystalline product remaining in the furnace is free from potash, and should contain from 95 to 99 per cent alumina. In case the ore contains more iron and silica than will permit of a product of this required purity, the impurities may be reduced to a 20 per cent ferrosilicon during the process of fusion by the addition of the required iron and reducing elements. (1,239,984; assigned to the Carborundum Co.; Sept. 11, 1917.)

Beta-alumina.—L. E. SAUNDERS and R. H. WHITE of Niagara Falls note that small amounts of beta-alumina have been noted in certain furnace products. It is so termed to differentiate it from alpha-alumina, occurring naturally as corundum, sapphire, ruby, etc., the two forms being distinguished by the lower refractive index, higher double refraction and lower specific gravity of the beta modification. It also has a characteristic platy, hexagonal crystalline habit, and is hard but relatively weak. It has special applications for abrasives which polish without leaving scratches. If substantially pure amorphous alumina be heated with somewhat more than five per cent of Na_2O as alkaline carbonate, the resulting pig will be found to contain from 70 to 85 per cent of the alumina in the beta modification. The alkaline compound must be chosen which will not be largely volatilized during the heating, since the alkaline oxide is probably the converting agent. The inventors think that the alkali additions yield a product of high boiling point which exists as vapor at the moment of solidification of the alumina, as evidenced by the cellular appearance of portions of the resulting pig. The effect of the alkali additions is seriously interfered with by SiO_2 and TiO_2 , and the raw materials must be substantially free from these harmful compounds. (1,263,708; assigned to Norton Co.; Apr. 23, 1918.)

Alumina from Impure Bauxite.—In case an impure bauxite containing after calcination about 4 per cent SiO_2 , 7 per cent Fe_2O_3 and 3.5 per cent TiO_2 is melted in a furnace such as patented in re-issue No. 13,027 with 2 to 3 per cent Na_2O , a dark gray, fine-grained product is produced. Messrs. SAUNDERS and WHITE find that this product has a weak grain desirable for certain purposes. Carbon may be introduced before

furnacing, which will produce material lighter in color, and with a smaller amount of the original and added impurities. In either case will any considerable amounts of beta-aluminium be formed. (1,263,709 and 1,263,710; assigned to Norton Co.; Apr. 23, 1918.)

Purifying Alumina.—If impure bauxite be heated with carbon in an electric furnace with an idea of forming crystalline material for refractories or abrasives, considerable alumina is reduced if the amount of carbon added approaches the theoretical quantity required to reduce the impurities. The tendency to form reduction products from the carbon of the furnace electrodes or bottom is very pronounced in fusing even the purest alumina, since the easily reducible oxides of iron and silica existing as normal impurities protect the alumina to a certain extent. L. E. SAUNDERS and R. H. WHITE of Niagara Falls have discovered that the reduced alumina, consisting of undesirable carbides and hypothetical sub-oxides which disintegrate when exposed to moisture, may be preserved from disintegration by adding to the furnace charge an appropriate amount of sodium or zinc compounds (from 1 to 5 per cent) and any excess of which volatilizes from the fused mass. The formation of undesirable weak, porous grains of alumina from these oxidizing additions may be obviated, together with a substantial absence of reduced aluminium compounds, by adding from 10 to 20 per cent of iron to the furnace charge. The molten iron absorbs the excess carbon and the reduced impurities and does not react with the fused alumina. Another method of refining alumina containing carbides is to mix it with impure bauxite similar to that forming the original charge. The quantity of impure material used should be such that the reduced aluminium compounds will react quantitatively with the iron, silicon and other oxides on a second heating. This method is particularly good, since it is believed that the reduction products of alumina are the effective reducing agents for the elimination of the last traces of non-aluminous oxides. (1,269,141, 1,269,222, 1,269,223 and 1,269,224; assigned to Norton Co.; June 11, 1918.)

Production of Magnesium.—G. O. SEWARD of Jersey City, N. J., patents an improvement to No. 935,796 for the manufacture of metallic magnesium. It consists of electrolyzing molten chlorides of magnesium and potassium, using a carbon anode and a cathode of molten tin or copper. The magnesium separated from the electrolyte is alloyed with the molten cathode, which is removed when it contains sufficient magnesium for further treatment. In the second step the magnesium alloy is used as anode, the electrolyte is of the same nature as before, except with the addition of a heavy salt of an electro-positive metal such as barium chloride. In the second electrolysis, magnesium enters the solution from the impure anode and deposits on the cathode, so arranged that the magnesium separated may float upon the electrolyte. The tin or copper remaining at the end is much more easily purified of the silicon, iron and calcium ordinarily present than is the formerly-used aluminium, while the magnesium resulting is not harmed by the traces of copper or tin contained. (1,258,261; assigned to American Magnesium Corporation; Mar. 5, 1918.)

Synopsis of Recent Chemical and Metallurgical Literature

"Nicu" Steel and Its Manufacture.—A paper advocating a radical revision in metallurgical practice as applied to the Sudbury nickel ores was read before the Montreal Metallurgical Association at the April, 1918, meeting, by G. M. COLVOCORESSES of Humboldt, Ariz. He noted the fact that Sudbury produced 85 per cent of the world's nickel, of which 75 per cent was added to open-hearth furnaces to produce nickel-steel. At the same time, 650,000 tons of iron valued at 14 million dollars contained in the Sudbury ores are slagged and wasted annually. Present metallurgical practice on nickel ores closely parallels copper smelting up to the production of a white metal containing 80 per cent combined nickel and copper, which converter product is further refined and separated by either the Orford or the Mond process. Available details of the mining and metallurgy of such ores are given fully in the excellent 1917 Report of the Royal Ontario Nickel Commission. Consideration of the average analysis of Sudbury ores given in Table I leads to the conclusion, however, that the ore is one of iron, and should be treated accordingly.

New Caledonia ships a garnierite ore, essentially a hydrous silicate of nickel and magnesium (Table I, which is ordinarily mixed with a sulphide ore for matte smelting. In 1880 some of this ore was locally smelted in a small blast furnace to a "fonte" or impure nickel pig, containing 66 per cent nickel and 24 per cent iron, but the process was not successful owing to a variety of reasons, including the difficulty of preventing considerable sulphur entering the pig from impure coke. More recently, however, this ore has been smelted with iron ores in the electric furnace and the best nickel-steel produced. The process bids fair to become standard for the treatment of this peculiar material.

Recent developments of the multiple hearth roaster have enabled one to dead-roast sulphide ores, using a relatively small amount of extraneous fuel to reduce the sulphur from 3 to 4 per cent to 0.3 to 0.5 per cent. Properly mixed with a flux, the calcine may be delivered in a nodulized condition suitable for blast furnace smelting. The coming of the electric furnace has also enabled the metallurgist to reduce the sulphur in steel made from fairly impure materials to any reasonable amount. Evidently, then, the Sudbury ores could now be roasted and smelted direct, were it not for the universal prejudice existing against any alloy steels containing copper. This is in spite of such results as were obtained in 1909 by Burgess and Aston, who concluded that copper would replace nickel satisfactorily to a certain extent in low carbon alloy steels. Clamer also experimented carefully and took out patents on a method of smelting roasted copper-nickel matte with iron ores into a satisfactory alloy steel. Monel scrap (containing 70 per cent Ni, 27 per cent Cu) has been extensively used in place of pure nickel in the manufacture of alloy steels which have sold under the name of "nickel-steel," withstanding successfully various physical tests, and being manufactured into ar-

mor-piercing shells and high grade automobile parts.

Sjostedt and Ulke of the Lake Superior Corporation (operating at the "Soo" in 1901) first worked on the production of ferro-nickel from Canadian ores. "Nicu" steel has been made in laboratory furnaces for several years, and in commercial quantities in a leased plant in East Montreal during the fall of 1917. A low grade ore was used which had been mined for some 20 years, and meantime had weathered, oxidized and disintegrated. This was roasted to 0.4 per cent S in a coal fired reverberatory heating furnace, hand rabbled. It was then charged to a 6-ton Heroult tilting furnace, six or eight charges of the following composition being required to make a heat:

1400 pounds calcine
535 pounds burned lime
375 pounds coke breeze.

Slag was poured at intervals, and the resulting pig, of the analysis given in Table I, refined in an open-hearth furnace of the standard type. No particular extra expense or trouble was encountered in this last

TABLE I—ANALYSES OF VARIOUS NICKEL-COPPER PRODUCTS

Element	Average Sudbury Ore	New Caledonia Garnierite	Weathered Ore Smelted	Pig Iron Produced	Steel Made
Ni	3.25	5	1.3	2.2	2.13
Cu	1.7	..	0.28	0.4	0.4
Fe	46.0	10	46.0	0.09	0.03
S	25.0	..	8.0	0.07	0.006
P	..	..	..	1.75	0.03
Si	20.0	33	19.0	3.0	0.2
C	..	..	..	..	..

operation; 72 tons of steel were made, and subjected to a wide variety of tests demonstrating it to be apparently equal to nickel-steel whose Ni content equalled the Ni + Cu in the "Nicu" steel.

The author presents cost data which lead to the conclusion that under 1916 conditions "Nicu" steel equivalent to a 3 per cent nickel-steel (selling at \$60) can be produced in quantity at \$30 per ton, scrap being figured at \$16 per ton. The process recovers 98 instead of the present 80 per cent of the nickel in the ore, 98 instead of 83 per cent of the copper, and 96 per cent instead of none of the iron. The increased saving if applied to all Sudbury ores would amount to \$41,000,000, which is practically equal to the present returns. In commercial operation on a large scale, the nodulized calcine would be mixed with iron-silicate slags and iron ores and smelted to an alloy pig containing 0.2 per cent sulphur. The molten pig would be charged directly to the refining furnace, where a basic slag would remove the bulk of the remaining sulphur and the composition could be carefully adjusted to specification.

Size of Grog in Fire Clay Bodies.—In Technologic Paper No. 104 of the Bureau of Standards F. A. KIRKPATRICK discusses the effect of the size of grog upon the strength and other properties of fire clay bodies. The grog was made by crushing and sizing high-grade fire brick to the following fractions: 4 to 8 mesh, 8 to 12, 12 to 20, 20 to 40, 40 to 80, and 80 to dust. Various combinations of these fractions were then made, proportioned with 50 per cent by weight of plastic fire clay ground through 20 mesh, and molded by hand into briquets 1 x 1 x 7 in. Seven series of mixtures were studied, sufficient work being done to construct tri-axial diagrams showing lines of equal strength, porosity, etc.

Unburned briquets were air dried three days, then one day at 65 deg. C. and two days at 110 deg. Seven briquets of each mixture were broken in a transverse bending machine and the modulus of rupture averaged to give a value for strength. The porosity was determined by immersing in kerosene for 12 hours at 0.2 atmosphere and determining the increase in weight. The tri-axial diagrams representing the modulus of rupture for the various mixtures show iso-strength lines. Some of the series were not coördinate in results for porosity and strength, which phenomenon the author explains thus: The porosity of briquets made of large grog is less than those containing moderately fine particles because the larger particles are more dense than an equal weight of packed smaller ones, and also because the voids were increased by a mixture of grog-sizes. The strength of certain of these mixtures, however, varies directly instead of inversely with the porosity (which latter is the general rule for ceramic materials) because in these cases the larger particles of grog gave weaker bodies due to a lack of bond and contact between clay and grog, causing small cracks in drying. These cracks were the finer with fine aggregates of grog. If the ratio of size and shape of the voids in clay-grog bodies is such that the smaller particles do not fit into the voids but separate the larger bodies, then there will be no areas of maximum strength or density appearing in the corresponding tri-axial diagrams. As above noted, a mixture of sizes giving the maximum density by packing into the voids left by each larger size gives the highest strength.

In mixtures where half the fire clay was replaced by Georgia kaolin the corresponding briquets decreased 60 per cent in strength. When the fire clay was totally replaced by Illinois kaolin, however, corresponding mixtures showed less bonding power with coarse grog but very much more with fine grog than had the pure fire clay. Mr. Kirkpatrick notes that the kaolin was of putty-like consistency, while the fire clay was sticky and contained more colloidal matter. Therefore, kaolin should be expected to make weaker—less dense—mixtures. However, kaolin evidently had certain percentages of grains fitting into the voids between the finest grog, giving with these more dense and stronger bodies. The author concludes that the size of grain of the bond clay has as much effect as that of the grog. Since the size of grain of clay cannot be directly determined in the present state of our knowledge of disperse systems, systematic experimentation such as is done in this publication appears to be the only method of determining the best mixtures for strength and other physical characteristics.

Burned briquets were tested in three series: one burned two hours at 1200, another at 1250 and the third at 1300 deg. C. After burning, the briquets were tested for strength in bending. In these tests the average difference from the mean value was about 10 per cent. Burned briquets were also tested for porosity, volume shrinkage and resistance to sudden temperature changes. In the latter test six pieces of each composition were heated to 600 deg. C. and quenched in ice water five times in succession, the modulus of rup-

ture was determined, and the percentage diminution computed. The number of quenchings to produce failure seems to be no criterion for small pieces, but the author determined that a standard brick should resist from two to three times as many quenchings as the 1 x 1 x 7 in. briquets.

The test results show an erratic relation between porosity (or shrinkage) and strength. The conclusion is that the porosity should not be taken as a criterion of strength in a burned brick, because its effect is often overridden by other factors. However, the relation between the "surface factor" of the grog and the strength of the briquet plots as a straight line (except for regions of large grog sizes) for all three heat treatments and is therefore an accurate index of the strength. The rate of gain in strength increases with temperature of burning, since the rate of solution of the finer particles is more rapid. The coarser grog mixtures stood the quenching tests best, and since the results at 600 deg. C. closely agree with those at 1000 deg., the lower and more readily handled temperature is recommended for such work. A grog furnished by a large maker of refractories approximated closely one of the mixtures giving a maximum strength, showing that a good surface factor can be had in practice by careful attention to the crushing system.

Effect of Dielectric Deposits on Cottrell Operation.—E. R. WOLCOTT in the *Physical Review*, Vol. 12, p. 284, notes that early experience with certain Cottrell plants developed the baffling fact that after operation for a few hours the potential difference between electrodes was lowered to such a degree that the designed power input could not be carried below a safe amperage. This phenomenon occurred in plants treating a non-conducting fume, like sulphur. He therefore investigated the effect of various substances interposed in the gap between a spark and plate, and re-established the previously known facts that the sparking potential is greater if the point is negative for gaps larger than 2.3 mm. (being 2½ times as great at 6 cm.); that the voltage required to start a spark is greater than that necessary to maintain it; and that the voltage required to arc a considerable amperage is higher than that producing a snappy spark consuming a very small amount of power. In addition he found that introducing dielectrics into the gap produced changes in the arcing voltage varying as their nature, continuity, surface condition and position. By careful adjustment a silent glow was produced and photographed, showing it to emanate from the edge of a perforation in a piece of paper resting on the plate. Edges or perforations in thin sheets of mica and glass and a very thin deposit of flowered sulphur or sintering-machine dust was sufficient to lower the arcing voltage approximately one-half.

The roughened, porous or discontinuous surface accumulates a charge sufficient to ionize the surrounding gas, producing the typical glow of the positive discharge and increasing the conductivity of that portion of the gap. No lowering of the sparking voltage results when this charge is conducted away, such as is done by precipitated moisture or by a superimposed grounded screen.

Reinforced Waterproof Paper

Arthur D. Little, Inc., of Cambridge, Mass., have perfected a cotton cloth reinforced waterproof paper which will soon be placed on the market. Heavy grades as strong as burlap such as packing house concerns use for heading barrels of provisions will also find special use in making packages for various chemicals.

Book Reviews

TECHNICAL CHEMISTS' HANDBOOK. By *George Lunge*, Ph.D. Flexible leather, duodecimo (12 x 18 cm.), 264 pages; price \$3.50 net. New York: D. Van Nostrand Company.

The second edition of this well-known handbook. It is brief, condensed, and the data well chosen. The analytical methods cover the manufacture of heavy inorganic chemicals only, and not metallurgy, inorganic chemistry, or the finer chemical products. In each case only the best, standard method is given, "in order to avoid discrepancies." It can thus be seen that the spirit of the work is eminently practical, and not one of scientific precision.

HANDBOOK OF OIL ANALYSIS. By *Augustus H. Gill*. Pages 210. Price \$2.50. Philadelphia: J. B. Lippincott Co.

The excellent handbook of oil analysis by Dr. Gill has now reached an eighth edition. This bespeaks in striking terms its widespread usefulness in the arts with which it deals. The additions and changes noted in this edition cover a description of the new McMichael viscometer and tests on lubricating oils, some revision of special oils and greases, and methods of the analysis of edible and hardened fats and oils have been brought up to date. For a handy, condensed and competent book on the analysis of oils, this book is to be recommended for a laboratory text book and ready reference.

ORGANIC COMPOUNDS OF ARSENIC AND ANTIMONY. By *Gilbert T. Morgan, D.Sc.*, Professor of Applied Chemistry, City and Guilds Technical College, Finsbury, London, England. Longmans, Green & Company, 1918. 8vo., 376 pp. Price \$4.80 net.

The appearance of such an excellent monograph as Professor Morgan's will be welcomed, not only by those to whom the work will be useful, but by all chemists who derive a certain amount of satisfaction in knowing that an important special field of research has been mapped in a thorough manner.

It is a pity that our universities, burdened as they are financially, are practically unable to subsidize or otherwise encourage their professors to write scientific works other than Outlines, Introductory Courses, General Principles etc., such as underpaid and overworked professors are in the habit of writing in order to buy bread and beans for themselves and their families. Professor Morgan's excellent book is therefore most unusual. The thought even suggests itself that the trustees of the City and Guilds College of Finsbury, London, must have had their attention diverted by something, perhaps the war, or they might have seen to it that Professor Morgan did not have "leisure" or "spare time" to write such a book.

It seems to the reviewer that Professor Morgan's book embodies all the features which an excellent scientific monograph should. It contains an excellent bibliography and discusses all of the earlier work which is important, including particularly the work of Béchamp. The author uses structural formulae freely, which greatly facilitates following the chemical changes involved in what are fairly complex substances. The subject is brought practically up to date, that is up to the end of 1917. The author naturally gives considerable attention to atoxyl and its derivatives and the developments which led to the discovery and application of salvarsan, neosalvarsan, luargol, gallyl

etc. While the details of the preparation of many of these compounds are given, it might have been pointed out that the successful preparation of many of them requires a degree of skill and experience such as comparatively few organic chemists attain.

The chemistry of the organic compounds of antimony places this series of compounds with those of arsenic and Professor Morgan has dealt with them in the same thorough manner as the arsenic derivatives, although the latter have proven of much greater value to the physician.

The clinical results of many thousands of cases are given which indicate the latest results of clinical practice with all of the more important derivatives, including the newest. While evidently intended primarily for chemists, the book will undoubtedly prove of value and interest to physicians as well.

Personal

MR. C. E. LEN. ARNOLD, formerly with the Inspiration Consolidated Copper Co., at Inspiration, Ariz., has accepted a position with the Consolidated Arizona Smelting Co. at Mayer, Ariz.

MR. JAMES CHESTER ASHBY, who has been instructor in chemistry at Lehigh University, South Bethlehem, Pa., for some time, is now with the Buffalo Works of the National Aniline & Chemical Co. in the research laboratory.

MR. F. D. BAKER, who has been with the Colorado Department of the American Smelting & Refining Co. for twenty years as chief designing and construction engineer, retired Jan. 1, 1919. Mr. Baker will continue work in a limited consulting practice at Denver, Colo., with his sons.

MR. CHARLES Y. CLAYTON, recently with the Department of the Interior, Bureau of Mines, Pittsburgh, Pa., has become connected with the Missouri School of Mines, Dept. of Metallurgy and Ore Dressing, Rolla, Mo.

PROF. G. H. CLEVINGER is now with the National Research Council, Washington, D. C., having completed the research work at Colorado Springs for the U. S. Bureau of Mines.

MR. W. M. CORSE, who was general manager of the Titanium Bronze Co., Niagara Falls, N. Y., has accepted a position as manufacturing engineer with the Ohio Brass Co., Mansfield, Ohio.

DR. R. W. HESS has recently accepted a position as senior research chemist with the National Aniline & Chemical Co., Buffalo, N. Y. He was formerly chemist in the dye-stuff department of the Chicago plant of the Sherwin-Williams Co.

DR. T. POOLE MAYNARD, Atlanta, Ga., has been made Southern representative of the Research Corporation of New York.

MR. LOUIS O. MONROE has assumed duties as manager of sales and chief engineer for the Clarage Fan Co., Kalamazoo, Mich. Previous to entering the service he was in charge of the Chicago office of the same company.

MR. H. C. PARMELEE, editor of *CHEMICAL & METALLURGICAL ENGINEERING*, has returned from a two-months' visit to England and France, where he was the guest of the British Government.

MR. A. J. PHILIPPS is now research chemist with the Aetna Explosives Co., Emporium, Pa. He was formerly chief chemist of the Western Alkali Refining Co.

MR. FREDERICK A. SCHEFFLER has become associated with the Fuller Engineering Co. and will make his headquarters at the company's New York office, 50 Church St., Mr. Scheffler was formerly identified with the Babcock & Wilcox Co.

MR. K. B. THOMAS has resigned his position Jan. 1, 1919, as superintendent of the sulphuric acid department for the Calumet & Arizona Mining Co., Douglas, Ariz., to become associated with the Standard Chemical & Oil Co. of Troy, Ala., as its superintendent.

MR. HORACE N. TRUMBULL, who has recently received his discharge from the Engineers Officers' Training School at Camp A. A. Humphreys, Va., has been appointed advertising manager of the Wellman-Seaver-Morgan Co., of Cleveland, Ohio. Before entering the service, Mr. Trumbull was advertising manager of the S.K.F. Ball Bearing Co., Hartford, Conn.

MR. F. L. WOODS has been appointed superintendent of the Tygert-Allen Works at Philadelphia, Pa., of the American Agricultural Chemical Co., of Weymouth, Mass. He was formerly assistant superintendent of the Bradley fertilizer works of the same company at Weymouth.

Obituary

MR. THOMAS G. BROWN, of Denver, Colorado, died at Lluvia de Oro, in Chihuahua, Mexico, on November 19 of pneumonia following influenza. He was 31 years of age and was graduated from the Golden School of Mines in 1907. After graduation he spent some time in Colorado, being employed at the Tomboy and other mines. In 1910 he joined the staff of the Mines Company of America and was employed at both the Dolores mine, in Chihuahua, and the Creston-Colorada, in Sonora, for a number of years. In April, 1917, he became assayer and chemist for the Lluvia de Oro Gold Mining Co., and in that capacity he was serving at the time of his death.

Current Market Reports

The Non-Ferrous Metal Market

Saturday, Jan. 11.—There has been no buying on any large scale up to date this year. In several cases there have been declines in prices, which are certain to rapidly reach a peace basis. Manufacturers will not order their metal supplies before orders for their product are booked.

Aluminium:—The Government prices on ingots 98 to 99 per cent Al are \$660 a ton f.o.b. plant in 50-ton lots; \$662 down to 15-ton lots; and \$666 down to 1-ton lots, which prices will continue the remainder of the year. Prices per pound for small lots vary from 40c. to 45c.; sheet aluminium, 18 ga. and heavier, 42c.; powdered aluminium, 100 mesh, 70c.

Antimony:—Large stocks of antimony are being held at prices ranging from 7½ to 8c. per lb.

Copper:—Prime lake is nominal at 23c. Electrolytic is selling at 20½c. and casting at 19c. The producers are determined to hold their prices high believing that the foreign demand will soon be strong.

Copper sheets, hot rolled.....lb.	\$0.33	— \$0.35
Copper sheets, cold rolled.....lb.	.34	— .36
Copper bottoms.....lb.	.41	— .43
Copper rods.....lb.	.33	— .35
Copper wire.....lb.	.23	—
High brass wire.....lb.	.24	— .26
High brass sheets.....lb.	.24	— .26
High brass rods.....lb.	.23	— .25
Low brass wire.....lb.	.26	— .28
Low brass sheets.....lb.	.26	— .28
Low brass rods.....lb.	.27	— .29
Brass tubing.....lb.	.35	— .37
Brass bronze tubing.....lb.	.40	— .42
Seamless copper tubing.....lb.	.35	— .37
Seamless bronze tubing.....lb.	.37	— .39
Seamless brass tubing.....lb.	.34	— .36
Bronze (gold) powder.....lb.	1.00	— 1.75

Tungsten:—Tungsten took a decided decline with best grade scheelite \$18.00 and wolframite \$16.00.

Zinc:—Spelter continues to decline, spot New York bring \$156 to 157 per ton; East St. Louis, \$148 to 150, February, \$147 and March, \$146. Sheet and plate zinc is quoted at 13c. per lb. and prime metallic powder, 14c. lb.

OTHER METALS

Bismuth.....lb.	\$3.50	— \$3.65
Cadmium.....lb.	1.50	—
Cobalt.....lb.	2.50	— 3.50
Magnesium.....lb.	1.75	— 2.10
Mercury.....75 lb.	110.00	—
Nickel.....lb.	1.95	—
Tungsten.....lb.	.40	— .45
Iridium.....os.	34.00	—
Palladium.....os.	175.00	—
Platinum.....os.	135.00	—
Silver.....os.	105.00	— 108.00
	1.01	—

Lead:—Buyers are not taking much interest in lead at present. East St. Louis prices are from \$112 to \$114 per ton; New York, 5½ to 6c. lb.; sheet lead is 9c. lb.

Tin:—The tin market is divided into two sections: Government 72½c. tin and outside lots at 70½ with an expected decline to 68c. per lb.

The Iron and Steel Market

Demand for iron and steel since the signing of the armistice has pursued a somewhat different course than was generally expected. Instead of the sudden cessation of hostilities producing a sudden slump in demand with a sharp curtailment in production, to be followed by an early pick-up in demand, the reverse has been the case. For several weeks after the signing of the armistice there was no plethora of steel although production was very well maintained, while now, in the middle of January, steel mill operations are decreasing and there is only a very meager demand.

Production of steel ingots in December was at the rate of 43,750,000 tons a year, showing actually an increase over the November rate, which was 43,000,000 tons a year, not counting time out for celebration of the armistice, while the maximum rate ever attained was 46,800,000 tons, last September. The December rate represented about 90 per cent of capacity, which may be taken at 49,000,000 tons a year. Mills are operating at various rates, but the average seems to be only about 65 per cent, and in view of the lightness of demand a 50 per cent rate is far from impossible in the near future. A 50 per cent rate on present capacity would represent approximately as large an output as was made in any calendar year prior to 1912, so that it really would represent a great deal of steel after all.

PRICES

There is no question about pig iron and steel prices, in face of the light demand. They are strictly maintained, in accordance with the reductions that were made in accordance with the schedule prepared by the Institute committee for presentation to the War Industries Board at the meeting of December 11. The board did not receive the schedule, but the iron and steel industry was keen and efficient to accept and adopt the suggestion. Broadly speaking, the reductions were \$3 on pig iron, \$4 on unfinished steel and \$4 to \$7 per net ton on finished products.

It is the lightness of demand that dispels any question about the maintenance of these slightly reduced prices, which are, of course, about double the ten-year pre-war average. There is no incentive on the part of producers to cut prices, slightly or heavily, for there will be more buying for a time at established prices than there would be in a disorganized market, and further cuts could hardly be made without precipitating demoralization. The time will come when it will be advantageous for the producers to bargain with buyers, when the buyers appear in such force as to show that price really counts. At the present time buying is of purely hand to mouth character.

The present demand, such as it is, does not represent new buying in any considerable measure, but rather, in the case of pig iron, the acceptance of shipments against old contracts, and in steel products the placing of specifications or shipping orders against old contracts. In steel products the contracts are, as is well understood, but little more than options given the buyer, who specifies or not as he desires. For this reason steel is being furnished under old contracts at the reduced prices, the mills readily making the necessary adjustments with customers. Even the sheet manufacturers, who adopted the "binding form" of contract a couple of years ago, have made these adjustments. The blast furnaces, which make firm contracts, not option-contracts such as obtain in the steel trade, are as a rule making the \$3 concession to customers.

CHARACTER AND DEMAND

By far the heaviest steel demand at present is from the automobile trade, which will probably use more steel than ever during the next few months. The Emergency Fleet Corporation is taking a considerable tonnage, but its re-

quirements are scaled down from the rate that obtained in the closing months of the war, as there is a large accumulation of steel, more than a million tons, to be worked off. Jobbers are buying and specifying moderate tonnages, requiring very prompt deliveries in all cases and being quite unwilling to commit themselves as to the future. Much the same policy obtains with ordinary manufacturing consumers. There is practically no demand for steel for regular construction jobs, buildings, bridges, factories, power stations and the like, nor is there any evidence that such demand will develop in the near future.

There is some cleaning up of orders for railroad steel, very little in rails, but a fair tonnage in car and locomotive material. There is no new business in sight in railroad steel, and a comprehensive program of railroad buying cannot of course be formulated until it is determined what is to be done with the railroads. Congress will take its own time in that matter.

Throughout the iron and steel trade the prediction is still made freely and with confidence that there is in store a period of several years of great activity. It is likewise admitted that the period will not begin for a while yet, a period of readjustment intervening. Apparently this readjustment is expected to proceed under its own steam and its own guidance. It does not seem to be regarded as anybody's business to help the readjustment along or even to study the subject. One branch of this readjustment, however, must properly be left to circumstances. There must be awaited a dying out of the wave of bolshevism in Europe, and certain psychological reactions in the minds of workmen in the United States, whereby they will become disposed to regard a job as an asset and become willing to render a day's service for a day's wage.

Chemical Market

COAL-TAR PRODUCTS:—Although there is a continued dullness in the coal-tar product market, it would seem that more than the ordinary seasonable quietness is prevailing, to such an extent that many of the items that come under this heading are almost at a standstill. At the present it is too early in the year to have had any material effect, although there is a strong undertone evident and inquiries in the trade for export purposes have been quite active, but the shipping situation is generally considered the handicap for extensive trading in this direction. It is believed, however, that as soon as this condition develops to be easier a splendid business will set in. Toluol is now in easy supply, with phenol being freely offered in the market at some unheard of prices, but producers appear to be in a position to keep benzol in a firm condition, although stocks on hand are plentiful.

Toluol:—Resale offerings of this product are made at 5c. below the manufacturer's price, while quotations from first hands are firm at the recent decline.

Phenol:—The material has developed to be the most unsettled product of the crudes. Producers are making price concessions with no favorable results and the offerings through second hands, which are 10c to 15c below the manufacturer's prices, seem to originate no buying interest.

Benzol:—This product is subject to no pressing call; however, it is held in strong hands and prices are firmly maintained.

Phthalic Acid:—The item is being produced in more liberal quantities and therefore the additional demand that has been in evidence during the recent period has not affected the situation to any noticeable extent. Manufacturers' prices are quotably unchanged for the crude or the anhydride.

Acid Sulphanilic:—Dealers are looking forward to some activity for this material, which has been considerably neglected, and no price revisions have taken place in view of this feeling.

Aniline Oil:—Up to the present writing there has been no price change reported for this product, which continues in light demand.

Aniline Salt:—Price concessions are being made by manufacturers and dealers, but consumers are seemingly purchasing only for immediate needs. Stocks in the various directions are in sufficient quantities to take care of additional business.

Benzaldehyde:—The routine demand that is in evidence for this product is well taken care of, as supplies in the market are now considerably easier and there has been a general decline in prices.

Benzidine:—Buyers are still holding off and the only business of importance that is passing is for the base material, while the sulphate seems to be considerably neglected and manufacturers have made some substantial downward revisions in prices.

HEAVY CHEMICALS:—Actual business in heavy chemicals during the interval has been of moderate proportions. However, the holiday season passed and the inventory period nearing completion seems to be a source of satisfaction throughout the trade, although there are no indications of any immediate activities and it is generally believed this will not take place until conditions are more favorable for export purposes. In the meantime most of the items that come under this heading have been subject to a decline in prices, with only the medicinal products holding firm. Caustic soda and soda ash, the barometers of the heavy chemicals, have again come in for a trying period and weak holders play havoc with the market.

Caustic Soda:—The tone of this market has been decidedly easier during the latter period of the past week with buyers' views considerably below the market prices, which have declined from 10c. to 20c. per hundred pounds. The 76 per cent solid product from the warehouse was available at \$3.30 per hundred pounds, while ex-dock quotations range from \$3.20 to \$3.30, according to seller. Dealers during the latter part of the week were not disposed to offer f.a.s. owing to the unsettled conditions with labor at the docks. Ground caustic appears to be subject to no important call and was offered at from \$4.25 to \$4.50 per hundred pounds.

Soda Ash:—There is no indication of any immediate activity for any of the various packings and during the week light ash in hardwood barrels appears to have been the only one of the items subject to any call and this was for no pronounced quantity. Bags from the warehouse were quoted at from \$1.90 to \$2.00 per hundred pounds, while material rolling was offered at \$1.80 New York. Double bags at Middle Western shipping points were held at from \$2.40 to \$2.50, while material in regular barrels was quoted at \$2.30 to \$2.45 ex-warehouse and hardwood barrels were offered at \$3.35 f.a.s. Dense ash in barrels was held at \$3.50 f.a.s., and on the Pacific Coast offerings were heard at \$3.60 ex-warehouse.

Bleaching Powder:—Resale material has been rather difficult to dispose of; however, export drums appear to be the only item that has been subject to any noticeable call, while domestic drums are being more freely offered. At Niagara large domestic drums were quoted at \$1.90, while first hands were holding at 2c per pound and 3½c seems to be the general asking price for export drums, while in the resale market offerings were made at 3c to 3½c.

Bichromate of Potash:—Most dealers continue to quote 37c to 38c per pound for this material, for which manufacturers report a satisfactory call, but the consuming demand is not pressing and stocks are in sufficient quantities to take care of additional business.

Bichromate of Soda:—A fair inquiry prevails for this material both for export and domestic consumption. First hands report stocks in reasonable quantities and are quoting 18c to 18½c, while in the resale market frequent lots appear and sales are passing at from 17c to 17½c per pound.

Cyanide of Soda:—Most dealers continue to quote the 96 to 98 per cent product at from 30c to 31c per pound, while the chloride mixture of 73 to 76 per cent is held at 25c to 27c per pound and the chloride carbonate mixture is offered at from 20c to 21c. Movement is of no important character and only the routine business is in evidence.

General Chemicals

WHOLESALE PRICES IN NEW YORK MARKET JAN. 10, 1919

Acetic anhydride.....	lb.	1.00	—	1.25
Acetone.....	lb.	.25	—	.25
Acetic, 28 per cent.....	cwt.	5.00	—	5.50
Acetic, 56 per cent.....	cwt.	8.50	—	9.50
Acetic, glacial, 99 1/2 per cent, carboys.....	cwt.	19.00	—	19.20
Boric, crystals.....	lb.	.13	—	.15
Citric, crystals.....	lb.	1.24	—	1.25
Hydrochloric, C. P.....	lb.	Nominal	—	
Hydrofluoric, 30 per cent, in barrels.....	lb.	.08	—	.08 1/2
Lactic, 44 per cent.....	lb.	.14	—	.15
Lactic, 22 per cent.....	lb.	.06	—	.07
Molybdic, C. P.....	lb.	6.90	—	7.40
Nitric, 36 deg.....	lb.	Nominal	—	
Nitric, 42 deg.....	lb.	.08 1/2	—	.10
Oxalic, crystals.....	lb.	.36	—	.38
Phosphoric, 47-50 per cent paste.....	lb.	.07 1/2	—	.10
Phosphoric, ref. 50 per cent.....	lb.	.35	—	.40
Picric.....	lb.	.75	—	.85
Pyrogallol, resublimed.....	lb.	3.25	—	3.50
Sulphuric, 60 deg.....	ton	16.00	—	
Sulphuric, 66 deg.....	ton	25.00	—	
Sulphuric, oleum (Fuming), tank cars.....	ton	60.00	—	65.00
Tannic, U. S. P., bulk.....	lb.	1.40	—	1.50
Tartaric, crystals.....	lb.	.86	—	.95
Tungstic, per lb. of W.....	lb.	1.70	—	1.75
Alcohol, sugar cane, 188 proof.....	gal.	4.91	—	
Alcohol, wood, 95 per cent.....	gal.	.91 1/2	—	.92
Alcohol, denatured, 180 proof.....	gal.	.68	—	.69
Alum, ammonia lump.....	lb.	.07 1/2	—	.08 1/2
Alum, chrome ammonium.....	lb.	.18	—	.19
Alum, chrome potassium.....	lb.	.20	—	.22
Alum, chrome sodium.....	lb.	.12 1/2	—	.13
Alum, potash lump.....	lb.	.09 1/2	—	.10
Aluminium sulphate, technical.....	lb.	.02 1/2	—	.02 1/2
Aluminium sulphate, iron free.....	lb.	.04 1/2	—	.04 1/2
Ammonia aqua, 26 deg., carboys.....	lb.	.08 1/2	—	.09 1/2
Ammonia, anhydrous.....	lb.	Nominal	—	
Ammonium carbonate.....	lb.	12	—	13
Ammonium nitrate.....	lb.	(Fixed Price)	—	
Ammonium sulphate domestic.....	lb.	.07 1/2	—	.08
Amyl acetate.....	gal.	5.30	—	5.35
Arsenic, white.....	lb.	.11	—	.13
Arsenic, red.....	lb.	.65	—	.70
Barium carbonate, 99 per cent.....	ton	80.00	—	90.00
Barium carbonate, 97-98 per cent.....	ton	65.00	—	67.00
Barium chloride.....	ton	65.00	—	75.00
Barium sulphate (Blanc Fixe, Dry).....	lb.	.04 1/2	—	.05
Barium nitrate.....	lb.	.11 1/2	—	.12
Barium peroxide, basis 70 per cent.....	lb.	.30	—	.32
Bleaching powder, 35 per cent chlorine.....	lb.	.02	—	.03 1/2
Borax, crystals, sacks.....	lb.	.08 1/2	—	.08 1/2
Brimstone, crude.....	ton	65.00	—	70.00
Bromine, technical.....	lb.	.75	—	
Calcium, acetate, crude.....	lb.	.04	—	.05
Calcium, carbide.....	lb.	.12	—	.14
Calcium chloride, 70-75 per cent, fused, lump.....	ton	22.00	—	24.00
Calcium peroxide.....	lb.	1.50	—	1.70
Calcium sulphate.....	lb.	.22	—	.23
Calcium sulphate, 98-99 per cent.....	lb.	.09	—	.09 1/2
Carbon bisulphide.....	lb.	.08	—	.09
Carbon tetrachloride, drums.....	lb.	.15	—	.16
Carbonyl chloride (phosgene).....	lb.	1.10	—	1.50
Caustic potash, 88-92 per cent.....	100 lb.	.62	—	.65
Caustic soda, 76 per cent.....	100 lb.	3.30	—	3.50
Chlorine, liquid.....	lb.	.10	—	.12
Cobalt oxide.....	lb.	1.60	—	1.65
Copperas.....	lb.	.01 1/2	—	.02 1/2
Copper carbonate.....	lb.	.30	—	.31
Copper cyanide.....	lb.	.75	—	.78
Copper sulphate, 99 per cent, large crystals.....	lb.	.09	—	.09 1/2
Cream of tartar, crystals.....	lb.	.63	—	.68
Epsom salt, bags, U.S.P.....	100 lb.	2.75	—	
Formaldehyde, 40 per cent.....	lb.	.21 1/2	—	.22
Glauber's salt.....	lb.	.02	—	.02 1/2
Glycerine, bulk, C.P.....	lb.	.20	—	.21
Iodine, resublimed.....	lb.	4.25	—	4.30
Iron oxide.....	lb.	.06	—	.06 1/2
Lead acetate, white crystals.....	lb.	.17	—	.17 1/2
Lead arsenate (Paste).....	lb.	.15	—	.18
Lead nitrate, C. P.....	lb.	.85	—	.86
Litharge, American.....	lb.	.12	—	.14
Lithium, carbonate.....	lb.	1.50	—	2.05
Magnesium carbonate, technical.....	lb.	.16	—	.17
Nickel salt, single.....	lb.	.14	—	.15
Nickel salt, double.....	lb.	.12	—	.13
Phosgene (see Carbonyl chloride).....	lb.	1.10	—	1.50
Phosphorus, red.....	lb.	1.00	—	1.15
Phosphorus, yellow.....	lb.	.85	—	1.10
Potassium bichromate.....	lb.	.38	—	.40
Potassium bromide granular.....	lb.	1.25	—	1.26
Potassium carbonate calcined, 85-90 per cent.....	lb.	.38	—	.40
Potassium chlorate, crystals.....	lb.	.38	—	.40
Potassium cyanide, 98-99 per cent.....	lb.	.60	—	.70
Potassium iodide.....	lb.	3.75	—	3.80
Potassium muriate, 80-85 p. c. basis of 80 p. c.....	ton	300.00	—	350.00
Potassium nitrate.....	lb.	.27	—	.31
Potassium permanganate, U. S. P.....	lb.	1.30	—	1.50
Potassium prussiate, red.....	lb.	2.30	—	2.50
Potassium prussiate, yellow.....	lb.	.80	—	.90
Potassium sulphate, 90-95 p. c. basis 90 p. c.....	ton	Nominal	—	
Rochelle salts.....	lb.	.46 1/2	—	.48
Salammoniac, gray gran.....	lb.	.19	—	.20
Salammoniac, white gran.....	lb.	.16	—	.17
Salt soda.....	100 lb.	1.40	—	1.65
Salt cake.....	ton	18.00	—	20.00
Silver cyanide, based on market price of silver.....	oz.	.63 1/2	—	.64
Silver nitrate.....	oz.	1.95	—	2.00
Soda ash, 58 per cent, light, flat (bags).....	100 lb.	3.35	—	3.50
Soda ash, 58 per cent, dense, flat.....	100 lb.	.18 1/2	—	.20
Sodium acetate.....	lb.	.02 1/2	—	.03
Sodium bicarbonate, domestic.....	lb.	.17 1/2	—	.18 1/2
Sodium bicarbonate, English.....	lb.	.12	—	.14
Sodium bichromate.....	lb.	.18	—	.20
Sodium bisulphite, powd.....	lb.	.30	—	.35
Sodium chlorate.....	lb.	.16	—	.17
Sodium cyanide.....	lb.		—	
Sodium fluoride, commercial.....	lb.		—	

Sodium hyposulphite.....	lb.	3.10	—	3.50
Sodium molybdate, per lb. of Mo.....	lb.	2.50	—	
Sodium nitrate, 95 per cent.....	100 lb.	4.42	—	4.55
Sodium nitrite.....	lb.	.19	—	.20
Sodium peroxide.....	lb.	.35	—	.45
Sodium phosphite.....	lb.	.04	—	.04 1/2
Sodium prussiate, yellow.....	lb.	.34	—	.36
Sodium silicate, liquid (60 deg.).....	lb.	.03	—	.04
Sodium sulphide, 30 per cent, crystals.....	lb.	.02	—	.03
Sodium sulphide, 60 per cent, fused.....	100 lb.	.05	—	.06
Sodium sulphite.....	lb.	.05 1/2	—	.06
Strontium nitrate.....	lb.	.25	—	.30
Sulphur chloride, drums.....	lb.	.07 1/2	—	.09
Sulphur dioxide, liquid, in cylinders.....	lb.	.15	—	.40
Sulphur, flowers, sublimed.....	100 lb.	4.35	—	4.50
Sulphur, roll.....	100 lb.	3.70	—	3.85
Sulphur, crude.....	ton	65.00	—	70.00
Tin bichloride, 50 deg.....	lb.	.28	—	.29
Tin oxide.....	lb.	.90	—	1.00
Zinc carbonate.....	lb.	.18	—	.20
Zinc chloride.....	lb.	.15	—	.15 1/2
Zinc cyanide.....	lb.	Nominal	—	
Zinc dust, 350 mesh.....	lb.	.13 1/2	—	.14
Zinc oxide, American process XX.....	lb.	.10 1/2	—	.12
Zinc sulphate.....	lb.	.04 1/2	—	.06 1/2

Coal Tar Products (Crude)

Benzol, pure, water white.....	gal.	.22	—	.27
Benzol, 90 per cent.....	gal.	.25	—	
Toluol, in tank cars.....	gal.	.25	—	
Toluol, in drums.....	gal.	.30	—	.35
Xylol, pure, water white.....	gal.	.45	—	.55
Solvent naphtha, water white.....	gal.	.18	—	.25
Solvent naphtha, crude, heavy.....	gal.	.12	—	.15
Creosote oil, 25 per cent.....	gal.	.45	—	.55
Dip oil, 20 per cent.....	gal.	.35	—	.40
Pitch, various grades.....	ton	8.00	—	20.00
Carbolic acid, crude, 95-97 per cent.....	lb.	Nominal	—	
Carbolic acid, crude, 50 per cent.....	lb.	Nominal	—	
Carbolic acid, crude, 25 per cent.....	lb.	Nominal	—	
Creosol, U. S. P.....	lb.	.18	—	.20

Intermediates, Etc.

Alpha naphthol, crude.....	lb.	1.00	—	1.10
Alpha naphthol, refined.....	lb.	1.50	—	1.60
Alpha naphthylamine.....	lb.	.55	—	.60
Aniline oil, drums extra.....	lb.	.27	—	.30
Aniline salts.....	lb.	.40	—	.42
Anthracene, 80 per cent.....	lb.	6.00	—	
Benzaldehyde (f.f.c.).....	lb.	4.25	—	4.50
Benidine, base.....	lb.	1.45	—	1.60
Benidine, sulphate.....	lb.	1.15	—	1.25
Benzoic acid, U. S. P.....	lb.	1.90	—	2.15
Benzonate of Soda, U. S. P.....	lb.	1.75	—	1.90
Benzyl chloride.....	lb.	2.45	—	2.50
Beta naphthol benzoate.....	lb.	10.00	—	12.00
Beta naphthol, sublimed.....	lb.	.75	—	.85
Beta naphthylamine, sublimed.....	lb.	2.65	—	
Dichlor benzol.....	lb.	.15	—	.20
Diethylaniline.....	lb.	3.25	—	4.00
Dinitro benzol.....	lb.	.36	—	.38
Dinitrochlorobenzol.....	lb.	.39	—	.41
Dinitronaphthalene.....	lb.	.55	—	.60
Dinitrotoluol.....	lb.	.40	—	.50
Dinitrophenol.....	lb.	.49	—	.50
Dimethylaniline.....	lb.	.70	—	.73
Diphenylamine.....	lb.	1.00	—	1.10
H-acid.....	lb.	2.85	—	3.10
Metaphenylenediamine.....	lb.	1.85	—	2.05
Monochlorobenzol.....	lb.	.16	—	.19
Naphthalene, flake.....	lb.	.09	—	
Naphthalene, balls.....	lb.	.12	—	.12 1/2
Naphthionic acid, crude.....	lb.	1.20	—	1.30
Naphthylamine-di-sulphonic acid.....	lb.	1.00	—	1.10
Nitro naphthalene.....	lb.	.45	—	.50
Nitro toluol.....	lb.	.55	—	.60
Ortho-amidophenol.....	lb.	6.00	—	7.00
Ortho-dichlor-benzol.....	lb.	.15	—	.20
Ortho-toluidine.....	lb.	1.00	—	1.10
Ortho-nitro-toluol.....	lb.	.75	—	.85
Para-amidophenol, base.....	lb.	4.25	—	
Para-amidophenol, H. C. L.....	lb.	4.25	—	5.00
Para-dichlor-benzol.....	lb.	.15	—	.20
Paranitraniline.....	lb.	1.50	—	1.70
Para-nitro-toluol.....	lb.	1.50	—	1.60
Paraphenylenediamine.....	lb.	3.25	—	3.50
Para toluidine.....	lb.	2.25	—	2.50
Phthalic acid anhydride.....	lb.	3.25	—	3.50
Phenol, U. S. P.....	lb.	.20	—	.30
Resorcin, technical.....	lb.	4.50	—	5.00
Resorcin, pure.....	lb.	7.00	—	8.00
Salicylic acid U. S. P.....	lb.	.77	—	.85
Sulfol.....	lb.	1.50	—	2.00
Sulphanilic acid, crude.....	lb.	.31	—	.33
Toluidine.....	lb.	2.50	—	3.00
Toluidine-mixture.....	lb.	1.00	—	

Petroleum Oils

Crude (at the Wells)

Pennsylvania.....	bbl.	4.00	—	
Corning, Ohio.....	bbl.	2.85	—	
Somerset, Ky.....	bbl.	2.60	—	
Wooster, Ohio.....	bbl.	2.68	—	
Indiana.....	bbl.	2.28	—	
Illinois.....	bbl.	2.42	—	
Oklahoma and Kansas.....	bbl.	2.25	—	
Caddo, La., light.....	bbl.	2.25	—	
Corseana, Tex., light.....	bbl.	2.25	—	
California.....	bbl.	1.24	—	1.57
Gulf Coast.....	bbl.	1.35	—	
Mexican.....	bbl.	1.90	—	
Fuel Oil				
New York.....	gal.	.15	—	
Philadelphia.....	gal.	.10 1/2	—	
Baltimore.....	gal.	.07 1/2	—	.15
Pittsburgh.....	gal.	.07 1/2	—	.10 1/2
Texas.....	bbl.	1.85	—	2.35
Los Angeles.....	bbl.	1.65	—	

Gasoline (Wholesale)

New York, motor	gal.	.24	—	—
Gas machine	gal.	.41	—	—
72-76 degrees	gal.	.33	—	.39
76-72 degrees	gal.	.32	—	.37
67-70 degrees	gal.	.30	—	.36
Pittsburgh, motor	gal.	.25	—	—
Chicago, motor	gal.	.22	—	.23
Oklahoma, motor	gal.	.21	—	—
San Francisco, motor	gal.	.20	—	—

Paraffine Waxes

Crude, 103 to 105 deg. m.pt.	lb.	.08	—	.09
Crude, 116 to 120 deg. m.pt.	lb.	.09	—	.10
Crude, 124 to 126 deg. m.pt.	lb.	.10	—	—
Refined, 120 deg. m.pt.	lb.	.13	—	—
Refined, 128 deg. m.pt.	lb.	.14	—	—
Refined, 135 deg. m.pt.	lb.	.16	—	.16
Ookerite, brown	lb.	.75	—	.80
Ookerite, green	lb.	.85	—	.90

Lubricants

Black, reduced, 29 gravity, 25-30 cold test	gal.	.24	—	.25
Cylinder, light	gal.	.45	—	.50
Cylinder, dark	gal.	.39	—	.43
Paraffine, high viscosity	gal.	.40	—	.41
Paraffine, 0.903 sp. gr.	gal.	.36	—	.38
Paraffine, 0.885 sp. gr.	gal.	.26	—	.28

Flotation Oils

(Prices at New York unless otherwise stated)

Pine oil, crude, f. o. b. Florida	gal.	.44	—	—
Pine oil, steam-distilled, sp. gr. 0.925-0.940	gal.	.58	—	.60
Pine oil, destructively distilled	gal.	.58	—	.60
Pine-tar oil, sp. gr. 1.02-1.035	gal.	.35	—	—
Pine-tar oil, double refined, sp. gr. 0.965-0.990	gal.	.42	—	—
Pine-tar oil, ref., light, sp. gr. 0.950, tank cars, f.o.b. works	gal.	.37	—	—
Pine-tar oil, ref., heavy, sp. gr. 1.025, tank cars, f.o.b. works	gal.	.28	—	—
Pine-tar oil, ref., thin, sp. gr. 1.060-1.080	gal.	.32	—	—
Turpentine, crude, sp. gr. 0.870-0.900	gal.	.45	—	—
Hardwood oil, f.o.b. Michigan, sp. gr. 0.960-0.990	gal.	.23	—	—
Hardwood oil, f.o.b. Michigan, sp. gr. 1.06-1.08	gal.	.23	—	—
Wood creosote, ref., f.o.b. Florida	gal.	.31	—	—

Naval Stores

Rosin A-E barrel	280 lb.	14.37	—	14.50
Rosin F-I	280 lb.	14.50	—	15.25
Rosin K-N	280 lb.	17.00	—	17.60
Rosin W-G-W	280 lb.	17.60	—	18.00
Spirits of turpentine	gal.	.66	—	.77
Wood turpentine, steam distilled	gal.	.64	—	.65
Wood turpentine, destructively distilled	gal.	.58	—	.60
Pitch	200 lb.	8.00	—	—
Tar, kiln dried	280 lb.	13.00	—	13.50
Retort tar	280 lb.	14.00	—	14.50
Rosin oil, first run	gal.	.77	—	—
Second run	gal.	.80	—	—
Third run	gal.	.85	—	—
Fourth run	gal.	.95	—	—

Vegetable Oils

Castor oil	lb.	.26	—	.28
China wood oil	lb.	.22	—	.24
Cocanut oil	lb.	.16	—	.21
Corn oil	lb.	.18	—	—
Cottonseed oil, crude	lb.	.17	—	.22
Linseed oil, raw, care	gal.	1.81	—	1.86
Palm	lb.	.18	—	.23
Peanut oil, crude	lb.	.17	—	—
Soya bean oil, Manchuria	lb.	.16	—	—

Glues

Extra white	lb.	.31	—	.35
Cabinet	lb.	.25	—	.26
Brown foot stock	lb.	.15	—	.19
Fish glue, 50-gal. barrels	gal.	1.00	—	1.50

Miscellaneous Materials

Barytes, floated, white, foreign	ton	Nominal	—	—
Barytes, floated, white, domestic	ton	33.00	—	36.00
Beeswax, white, pure	lb.	.63	—	.65
Beeswax, unbleached	lb.	.43	—	.48
Blanc fixe	lb.	.05	—	—
Casein	lb.	.17	—	.30
Ceylon graphite	lb.	.07	—	.25
Chalk, light, precipitated, English	lb.	.04	—	.06
China clay, imported, lump	ton	20.00	—	40.00
China clay, domestic, lump	ton	15.00	—	22.50
Feldspar	ton	8.00	—	12.00
Fluorspar, gravel, f.o.b. mines	ton	28.00	—	40.00
Fluorspar, washed, powdered	ton	90.00	—	—
Fuller's earth, powdered	100 lb.	1.50	—	2.00
Japan wax	lb.	.26	—	.27
Mexican graphite	ton	60.00	—	75.00
Madagascar graphite	lb.	.10	—	.15
Orange shellac	lb.	.72	—	.80
Pumice stone	lb.	.04	—	.08
Red lead, dry, carloads	100 lb.	.11	—	.11
Soapstone	ton	15.00	—	25.00
Stearic acid, 120 deg. m.pt.	lb.	.13	—	.14
Stearic acid, 140 deg. m.pt.	lb.	.18	—	.19
Talc, American, white	ton	20.00	—	40.00
White lead, dry	lb.	.14	—	.14

Refractories, Etc.

(F.O.B. Works)

Chrome brick	net ton	175.00	—	—
Chrome cement	net ton	75.00	—	—
Clay brick, first quality fireclay	per 1000	50.00	—	55.00
Clay brick, second quality	per 1000	35.00	—	40.00
Magnesite, raw	ton	30.00	—	35.00
Magnesite, calcined, powdered	ton	50.00	—	65.00
Magnesite, dead burned	net ton	50.00	—	60.00
Magnesia brick, 9x4x2	net ton	110.00	—	125.00
Silica brick	per 1000	50.00	—	60.00

Ferroalloys

Ferrocobaltitium, 15-18 per cent, carloads, f. o. b. Niagara Falls, N. Y.	ton	200.00	—	250.00
Ferrosilicon	lb.	15.00	—	30.00
Ferromanganese, per lb. of Cr.	lb.	.30	—	.40
Ferromanganese, domestic, 70 per cent basis	ton	220.00	—	—
Ferromanganese, English	ton	325.00	—	—
Spiegelisen (16-18%)	ton	67.50	—	—
Ferromolybdenum, per lb. of Mo.	lb.	3.50	—	4.50
Ferrosilicon, 75 per cent, f.o.b. N. Y.	ton	—	—	—
Ferrosilicon, 50 per cent, contract	ton	145.00	—	—
Ferrotungsten, 75-85 per cent, f.o.b. Pittsburgh	lb.	Nominal	—	—
Ferroumium, f.o.b. works, per lb. of U.	lb.	7.50	—	—
Ferrovandium, f.o.b. works	lb.	—	—	—

Ores and Semi-finished Products

Chrome ore, 45 per cent minimum, f.o.b. Cal. per unit	ton	1.50	—	1.55
Chrome ore, 43 per cent and over, New York, per unit	ton	1.40	—	—
Coke	ton	6.00	—	7.00
Manganese ore, 48 per cent and over, per unit	ton	1.20	—	—
Manganese ore, chemical	ton	80.00	—	100.00
Molybdenite, per lb. of MoS ₂	lb.	1.25	—	1.50
Tungsten, Scheelite, per unit of WO ₃	ton	25.50	—	—
Tungsten, Wolframite, per unit of WO ₃	ton	23.00	—	—
Uranium oxide, 96%	lb.	3.25	—	3.60
Vanadium pentoxide, 99%	lb.	10.50	—	—
Pyrites, foreign	unit	.17	—	—
Pyrites, domestic	unit	.28	—	.30

Plant Supplies

BUILDING MATERIALS

Common clay bricks	M	13.00	—	14.00
Hollow tile, 4x12x12	M	60.00	—	—
Hollow tile, 12x12x12	M	170.00	—	—
Lime	ton	16.50	—	—
Portland cement	ton	2.50	—	—
Single glass (82-lb.), 10x26-16x24	200 lb.	21.00	—	27.00
Double glass (164 lb.), 10x26-16x29	200 lb.	31.00	—	39.00
Yellow pine lumber	M	39.00	—	45.00
Fir lumber	M	38.00	—	53.00
Hemlock	M	24.50	—	40.00
Tarred felt (14-lb. sq.)	ton	68.00	—	—
Roofing pitch	ton	27.00	—	—
Asphalt coated roofing (35-55-lb. sq.)	sq.	1.60	—	2.45
Slate surfaced asphalt shingles	sq.	5.25	—	5.50
Corrugated galvanized iron	ton	109.00	—	127.00
Putty	100 lb.	6.25	—	—
Red oxide (Ppte. Copperas)	100 lb.	15.00	—	20.00
Native red oxide	100 lb.	3.25	—	8.00
Red metallic paint	100 lb.	1.20	—	1.50
White lead in oil	100 lb.	15.00	—	16.00
Red lead in oil	100 lb.	12.28	—	14.50
Zinc oxide (dry)	100 lb.	13.00	—	14.50
Zinc oxide—leaded	100 lb.	9.00	—	10.00
Yellow ochre	100 lb.	1.50	—	10.00
Ultra marine blue	100 lb.	14.00	—	50.00
Prussian blue	100 lb.	135.00	—	150.00
Chrome green	100 lb.	40.00	—	70.00
Paris green	100 lb.	43.00	—	49.00
Mineral black	100 lb.	1.75	—	2.25
Powdered bone black	100 lb.	5.50	—	12.00
Lampblack	100 lb.	15.00	—	45.00
Gas carbon	100 lb.	16.00	—	25.00
Mexican petroleum pitch	100 lb.	1.00	—	2.00
Gilsonite	100 lb.	2.00	—	2.50
Coal tar pitch	100 lb.	.60	—	1.25

STRUCTURAL IRON

Blue annealed sheet iron	ton	78.00	—	85.00
Black sheet iron	ton	94.00	—	100.00
Galvanized iron	ton	121.00	—	125.00
Tern plate, 8-lb. coating	ton	150.00	—	—
Tern plate, 15-lb. coating	ton	177.50	—	—
Tern plate, 25-lb. coating	ton	200.00	—	—
Tern plate, 40-lb. coating	ton	240.00	—	—
Tin plate, prime	ton	155.00	—	—
Tank plates	ton	60.00	—	—
Beams, channels, angles, T's, Z's	ton	56.00	—	—
Rivets	ton	88.00	—	92.00
Steel pipe, 1 to 3-inch	ton	51.00	—	—
Bar iron and steel	ton	60.00	—	70.00
Chain (1 inch proof coil)	ton	150.00	—	—
Nails, bolts, nuts, washers	ton	70.00	—	80.00
Tool steels, special alloys	ton	300.00	—	500.00
Bessemer pig iron	ton	32.00	—	35.20
Bessemer steel	ton	43.50	—	47.50
No. 2 foundry	ton	37.90	—	—
Steel billets (4 x 4)	ton	47.50	—	—

POWER HOUSE SUPPLIES

Steam packing, rubber duck	lb.	.99	—	1.10
Asbestos, high pressure	lb.	1.76	—	—
Asbestos, wired	lb.	1.30	—	—
Asbestos, graphited braid	lb.	1.21	—	—
Asbestos, wick	lb.	.75	—	—
Rubber, sheet	lb.	.66	—	—
Cup grease	lb.	.07	—	—
Transmission grease	lb.	.07	—	—
Axle grease	lb.	.04	—	—
Gear grease	lb.	.04	—	—
Cotton waste	lb.	.08	—	.11
Hose, underwriters, 2 1/2 in.	ft.	.75	—	—
Hose, air, 1 in.	ft.	.50	—	.60

INDUSTRIAL

Financial, Construction and Manufacturers' News

Construction and Operation

Arizona

DUNDEE—The Dundee-Arizona Copper Co. will build a treatment plant. A. J. Smith, secretary.

JEROME—The Shea Copper Co. will build its own concentrator in 1919. D. J. Shea, manager.

WALKER—The Black Diamond Mining & Development Co. will build a milling plant at its properties. C. N. Brown, manager.

Arkansas

MORRILLTON—The Commissioners of Sewer District No. 2 have awarded the contract for the construction of a sewer, involving 15,900 lin. ft. pipe, septic tank, etc., to S. R. Morgan & Co., Little Rock. Estimated cost, \$16,000.

California

BISHOP—The Montezuma Mines will install a concentrator for water and oil flotation concentration at its mine about six miles east of Big Pine. Estimated cost, \$30,000. A. Del Mar, superintendent.

LOS ANGELES—The Globe Grain & Milling Co., 901 East 3rd St., has awarded the contract for the construction of two 40 x 80 ft. and 40 x 60 ft. concrete buildings at 51st St. and Santa Fe Ave. for a hydrogen and oxygen plant, to Leonhardt & Peck, 721 H. W. Hellman Building. Estimated cost, \$25,000.

LOS ANGELES—The Los Angeles Graphite Co. will build a reduction plant for recovering graphite from Crescenta Canada tract, near here.

SACRAMENTO—The City Commissioners plan an election in April to vote on \$1,553,000 bond issue, \$1,200,000 of which will be used for the construction of a filtration plant. Thomas Coulter, commissioner of public works.

SAN FRANCISCO—The General Bond & Share Co., recently organized with a capital of \$10,000,000, will develop a 1200-acre lease of potash properties in the Searles Lake district. Plans include the construction of a large refinery. B. Schlesinger, First National Bank Building, secretary.

SAWTELLE—The Board of Public Works, Los Angeles, will install a modern septic sewerage plant to handle the sewage here. W. T. Knowlton, engineer.

Colorado

PUEBLO—The Midwest Refining Co., First National Bank Building, Denver, will build an oil refinery here.

Connecticut

BRIDGEPORT—Charles C. Fisher, Asylum St., will rebuild and equip the garbage disposal plant recently destroyed by fire, entailing a loss of \$25,000.

Florida

KEY WEST—The Bureau of Yards & Docks, Navy Department, Washington, D. C., received only one bid for the construction of a photo-laboratory here—from Ward & Pride, 307 Bisbee Building, Jacksonville, \$6,792. Noted Dec. 30.

Idaho

MULLAN—The Copper King Mining & Smelting Co. plans new development work at its local properties, to include the construction of a 50-ton mill. Estimated cost, \$25,000.

WALLACE—The Nabob Consolidated Mining Co. will build a concentrator having a capacity of 150 tons.

Iowa

MASON CITY—The city will build an experimental plant for the purpose of extracting the grease at the disposal plant. M. Conklin, chemist.

Kansas

PARSONS—The Missouri, Kansas & Texas R.R. will install a filtration plant at its yards near here. J. J. Johnitz, engineer, has completed plans for the work.

Kentucky

PADUCAH—The Diamond Fluorspar Co., 129 South 4th St., recently incorporated with a capital of \$99,000, will develop 119 acres of fluorspar properties in this section to have an initial capacity of about five tons daily; equipment and machinery will be installed shortly. C. L. Van Meter, manager.

Maryland

CRISFIELD—The borough will build a sewage disposal plant and sewer. Estimated cost, \$100,000. Norton, Bird & Whitman, Munsey Building, Baltimore, engineers.

SECURITY—The Security Cement & Lime Co., 125 West Washington St., will build a one-story, 50 x 50 ft. cement and lime plant. Total estimated cost, \$20,000.

Michigan

DETROIT—Frederick Stearns & Co., Jefferson Ave., has had plans prepared for the construction of an eight-story, 100 x 110 ft. drug manufacturing plant, at Jefferson Ave. and Bellevue St. Albert Kahn, Marquette Building, architect. Noted Dec. 30.

WYANDOTTE—The city will soon award the contract for the construction of a filtration plant, having a capacity of 4,000,000 gallons. Estimated cost, \$175,000. W. C. Lambert, mayor. Noted Aug. 15.

Minnesota

FAIRMONT—The city will receive bids in February or March for the construction of a 1,000,000 gallon water purification plant. E. L. Lewis, city clerk.

KEEWATIN—The village will build a sewage disposal plant. John Wilson, 300 First National Bank Building, Duluth, civil engineer, interested.

MINNEAPOLIS—The city will build a water-softening plant near the filtration plant. Estimated cost, \$300,000. F. W. Cappelen, city engineer.

Montana

SALTESE—The Tarbox Mining Co. will build a concentrating mill. William Wallace, superintendent.

Nebraska

LAKEVIEW—The Omaha Potash & Refining Co. will build a potash plant about twenty miles south of Lakeview. Estimated cost, \$500,000.

New Jersey

JERSEY CITY—The Vulcan Iron Works, Morris St., has had plans prepared for the construction of a one-story addition to its plant on Essex St. Estimated cost, \$8000.

New Mexico

CARRIZOZA—The Vera Cruz Leasing Co. will enlarge its existing mill to a 100-ton capacity and build a cyanide plant. R. B. Foster, president and manager.

Nevada

BATTLE MOUNTAIN—M. D. Farretta, Frank Childress and associates will place in operation a new 12-retort furnace for the reduction of cinnabar at their properties near here. John Ross, superintendent.

SEARCHLIGHT—The Big Casino Leasing Co. will build the first unit of its proposed plant; equipment, including two Deister-Overstrom roughing tables, a Herman ball mill flotation equipment and auxiliary apparatus, will be installed. F. E. Sharp, manager.

North Carolina

STANTONBURG—E. S. Darden and associates will establish an oil mill. Estimated cost, between \$75,000 and \$100,000.

Ohio

BELLAIRE—The Public Service Department has been authorized by the City Council to purchase one liquid chlorine machine for the filtration of the city waterworks. Estimated cost, \$1000.

CLEVELAND—The Ohio Metal Briquetting Co., 909 Schofield Building, has awarded the contract for the construction of a one-story, 52 x 177 ft. factory at 401 Literary Rd., to Crowell-Lundoff-Little Co., 5116 Euclid Ave. Estimated cost, \$30,000. Noted Nov. 15.

GENEVA—The city will build a sedimentation tank and filter bed for the waterworks plant. Estimated cost, \$6000. W. C. Goddard, city engineer.

Pennsylvania

MEADVILLE—The city will build a sewage disposal plant, on the George Bosler farm.

South Dakota

DEADWOOD—The Standard Oil Co. will enlarge its plant here in the spring.

Tennessee

COPPERHILL—The Tennessee Copper Co., 61 Broadway, New York City, will build a milling and flotation plant, having a capacity of 1000 tons daily; plans include the construction of a granulating plant. Arthur L. Tuttle, general manager.

Texas

ARANSAS PASS—E. C. Ryan, Aransas Pass, has announced that New York and Boston capitalists will finance the construction of an oil refinery to have a capacity of 30,000 barrels per day at Harbor Island. The project will include the construction of a pipe line from Ranger, docks and coal and oil storage facilities. Cost will run to \$15,000,000.

Virginia

HAMPTON—The Bureau of Yards & Docks, Navy Department, Washington, D. C., received only one bid for the construction of an oil storage and reclaiming building and a photographic laboratory at the Naval Air Station here—from R. R. Richardson & Co., Bank of Commerce Building, Norfolk, \$28,445.

NORFOLK—The Norfolk Glass Manufacturing Co., 564 Church St., will soon award the contract for the construction of a one and two-story plant near Berkely St. Estimated cost, \$200,000. Noted Dec. 30.

Washington

NEWPORT—The Bead Lake Copper Co. plans to build a new 100-ton concentrator at its properties on the Pend Orielle River.

Wisconsin

EAU CLAIRE—The Dells Paper & Pulp Co. has awarded the contract for the construction of a two-story paper mill to A. Larson & Co., 414 Main St.

HARTFORD—The International Steel Products Co., 1154 3rd St., Milwaukee, plans to build an addition to its factory in the spring. Estimated cost, \$30,000. O. C. Unke, general manager.

MILWAUKEE—The Perfection Metal Co., organized by George E. Meredith and others with a capital of \$99,000, will build a plant for the manufacturing and refining of metals.

MILWAUKEE—The Presto-O-Lite Co., 30 East 42nd St., New York City, N. Y., is receiving bids for the construction of a 1-story, 60 x 100 ft. compressor house for its branch filling station and service plant at 619 Trowbridge Ave. here.

British Columbia

ALERT BAY—The Beaver Cove Lumber & Pulp Co., Vancouver, will build a pulp and lumber mill. Estimated cost, \$750,000.

LAKE BUNTZEN—The American Nitrogen Products Co., 905 Securities Building, Seattle, Wash., will build a chemical plant here. Estimated cost, \$300,000.

SKIDEGATE—The South Eastern Mines will build a cyanide mill on gold property on Queen Charlotte Island which is being developed. A. S. Holmes, manager.

VANCOUVER—The Morrison Steel & Wire Co., Hawkes St., will rebuild its plant, which was recently destroyed by fire, entailing a loss of \$100,000.

Ontario

COBALT—The Wright-Hargreaves Gold Mines, Ltd., will build a new mill and is in the market for machinery for same.

ELORA—The Elora White Lime Co. will build a new crusher plant and install machinery in same. Estimated cost, \$60,000.

HAMILTON—The Steel Co. of Canada will build a benzol plant in connection with its coke ovens.

OTTAWA—The Honorary Advisory Council for Scientific and Industrial Research submitted report to Government recommending the construction of a four-story laboratory building to serve as a Central Research Institute. Estimated cost, \$500,000.

SANDWICH—The Dominion Forge & Stamping Co. will build a new plant and install machinery in same. Estimated cost, \$150,000. W. Herdegen, manager.

Quebec

CHICOUTIMI—Price Bros. & Co., 56 St. Peter St., will build a pulp mill. Estimated cost, \$1,000,000. Sir William Price, 145 Grand Allee, president.

MONTREAL—The Pyrene Manufacturing Co. of Canada, Ltd., 3 St. Nicholas St., will build a factory. Estimated cost, \$25,000.

TEMISKAMING—The Kippewa Fibre Co. has awarded the contract for the construction of twenty one-story, concrete buildings to be used as sulphite paper mills, to George A. Fuller Co., 45 St. Alexander St., Montreal. Estimated cost, \$3,000,000.

THREE RIVERS—The St. Maurice Lumber Co., 2 Notre Dame St., will build a pulp and paper plant. Estimated cost, \$500,000. R. F. Grant, manager.

Saskatchewan

HATTON—The Manitoba Gypsum Co., 504 Trust & Loan Building, Winnipeg, Man., will build a chemical plant here. Estimated cost, \$40,000. William Main, president.

Industrial Notes

THE AMERICAN TRANSFORMER CO., Newark, N. J., has moved into an enlarged factory at 178-182 Emmet St., which is just a few blocks from its former location.

THE BROWN HOISTING MACHINERY CO., Cleveland, O., announces the following changes in its organization: Mr. Harvey H. Brown, chairman of the board of directors; Mr. Alexander C. Brown, president; Mr. Melvin Pattison, vice-president, general manager and director; Mr. Robert G. Clapp and Mr. John F. Price, directors, and Mr. Ewen C. Pierce, general manager of sales.

THE PERCOL CHEMICAL CORP., Buffalo, N. Y., has created and is marketing sodium hydroxide and potassium hydroxide in tablet form. These tablets are made up in the U. S. P. grade purified by alcohol and also in the C. P. grade made up in one and two grams and packed in one, two and five pound bottles.

THE NASSAU VALVE & PUMP CORP., Rockville Center, L. I., has moved into new and more commodious quarters in Rockville Center, where its facilities for quantity production of acid resisting valves and pumps of solid antimonial lead are materially increased. The more expeditious routing of production afforded by the better plant layout and an increase in machine space and machinery, as well as increased foundry facilities, and the addition to plant personnel of a number of experienced mechanics besides those already employed make this company fully prepared to handle the after-the-war business of equipping fertilizer, smelting, refining, dye and chemical companies with acid resisting valves and pumps.

THE LUDLUM STEEL COMPANY, Watervliet, N. Y., announces the following equipment now installed, either ready for operation or nearing completion: One 12,000-lb. steam hammer with 72-inch stroke, necessary crane and gantry rigging; one vertical water tube steam boiler working off of waste gases from the heating furnaces; two new heating furnaces to be used in conjunction with this new hammer; electric motor drive with Falk gear for the 10-in. mill, replacing one 500-hp. steam engine. The steam boilers used for this steam engine will be coupled up to existing steam hammer capacity and three additional 1000-lb. and 1500-lb. steam hammers. New grinding room has just been completed and 24 grinders installed, with another 12, making 36 in all, nearing completion. This grinding room will be used exclusively for grinding high speed steel billets. This grinding room will be fitted up with runways and other labor-saving appliances for quick handling of heavy material. Two additional 6-ton furnaces are nearing completion with an additional 10-ton crane. The new furnaces will be the Ludlum Electric Furnace Co.'s product. The total installation of electric furnaces at the Ludlum Steel Co. is now three 10-ton

furnaces, three 5-ton furnaces and two 6-ton furnaces which have been made by the Ludlum Electric Furnace Corporation. A new annealing shop has just been completed containing six 15-ton annealing furnaces, and preparations are being made for the installing of two more of the same type of oil-burning furnaces.

THE NITRO PRODUCTS CO., Saginaw, Mich., is manufacturing naphthalene intermediates, specializing at the moment upon H-acid, for which they have equipment about completed to turn out regular and substantial quantities daily.

RICHARD K. MEADE & CO., Baltimore, Md., has moved its offices and laboratory from the Law Building to 11-13 E. Fayette Street.

THE ELECTRIC STEEL CO. of Indiana, Indianapolis, Ind., has been purchased by J. Rogers Halcomb and Roger B. Farquhar, Jr., formerly with the Midvale Steel Co. They will continue the business under the same name.

THE PHILADELPHIA ROLL & MACHINE CO., Philadelphia, Pa., has placed in operation a 25-ton acid open-hearth furnace. This company has also built a large pit annealing oven and a large core drying oven and is equipping the open-hearth building particularly for the manufacture of steel and steel alloy rolls.

THE SHARON STEEL HOOP CO. has started recently the No. 5 and No. 6 open-hearth furnaces in the battery at Lowellville, Mahoning County, Ohio. With the addition of these furnaces the monthly capacity of steel produced will be about 22,000 tons.

THE WESTERN RESEARCH CORP., 514-516 Eighteenth Street, Denver, Colo., has been organized by Carper, Ross & Co. and Mr. James M. McClave to handle the growing demand for industrial research and investigation. The business formerly conducted by Mr. McClave has been acquired by the new corporation and is to be greatly enlarged. A research laboratory is fully equipped to solve all problems in handling minerals, non-minerals, oil, etc., and develop efficient scientific methods of treatment, furnish reports on engineering, mining, metallurgical and chemical design and construction of mills and treatment plants, also development and financing of properties which have been investigated and approved.

THE BOOTH-HALL COMPANY, manufacturer of electric furnaces, Chicago, Ill., has placed in successful operation during the past few months the following steel melting furnaces: West Michigan Steel Foundry Co., Muskegon, Mich.; 3-ton basic castings for naval gun carriages; Monroe Steel Castings Co., Monroe, Mich.; 1½-ton acid-steel castings; Queen City Foundry Co., Denver, Colo.; 1-ton basic-steel castings for Emergency Fleet Corp.; New England Steel Castings Co., East Longmeadow, Mass.; 1½-ton acid-steel castings. In addition to these furnaces, there is also a 1-ton acid lined furnace in operation at the plant of the Durlin Castings Co., Dayton, Ohio, used for experimental work in the manufacture of durlon, and a 1½-ton furnace at the Avery plant, Peoria, Ill., basic, used for the manufacture of tractor castings.

THE WILPUTTE COKE OVEN CORPORATION, New York, N. Y., announces that the new byproduct coke oven plant of the Steel Co. of Canada, at Hamilton, Ont., will soon be in full operation. The plant consists of eighty 13-ton Wilputte regenerative byproduct coke ovens, arranged in two batteries of forty ovens each. The contract date of completion called for the first battery to be put in operation on Nov. 15, and in spite of all difficulties, due to abnormal conditions, the first battery was charged on the date stipulated in the contract. The installation is complete, including by-product plant, coal and coke handling, boiler plant, etc., and will have a capacity of approximately 500,000 tons of coal per annum. The plant was designed and constructed by the Wilputte Coke Oven Corporation, New York.

THE ELECTRIC FURNACE COMPANY, Alliance, Ohio, has closed a contract with the Braeburn Steel Co., Braeburn, Pa., for a large continuous recuperative annealing furnace, for the annealing of alloy steel bars and wire. This furnace will have a capacity for annealing 75 tons per day, and an electrical capacity of 600 kw. One of the special features is that the material is heated and cooled slowly and owing to the fact that it is a special alloy steel must be soaked for a considerable time at a maximum temperature without scaling and without the use of the usual annealing box covers.

THE VANADIUM-ALLOYS STEEL CO., of Pittsburgh and Latrobe, Pa., manufacturers of high speed and alloy tool steels, have leased the offices and warehouses at 566-568 West Randolph Street, Chicago, Ill. This company will carry in Chicago a large stock of "red cut superior" high speed steel in all the standard sizes and shapes of bar stock, also treated bits for tool holders. Owing to the size of its new warehouses this company will now carry a much larger stock than formerly with which to serve Chicago and contiguous territory.

THE WELLMAN-SEEVER-MORGAN COMPANY of Cleveland, Ohio, has opened a San Francisco office at 415-417 Rialto Building, in charge of Norman S. Ross. Business originating from California, Nevada west of the 115th meridian, Lower California and the counties of Josephine, Jackson and Klamath in Oregon will receive the prompt attention of Mr. Ross.

MARDEN, ORTH & HASTINGS CORPORATION opened a new office in the Syndicate Trust Building, St. Louis, on Jan. 2, which is the eleventh branch of this corporation. The company's head office is at 136 Liberty Street, New York City. Mr. Lewis, who was formerly connected with the Chicago branch of the corporation, will have charge of the sales of chemicals, oils, dyestuffs and intermediates and tanning materials. The edible oil departments will be in charge of Mr. Schnabel, who was formerly in charge of the same departments at the Louisville branch. The St. Louis office has been opened for the greater convenience of the many customers of the corporation in Missouri and adjoining states, who will receive prompter attention by directing all inquiries to the new office.

THE INTERNATIONAL OXYGEN CO. announces the removal of its general offices from 115 Broadway, New York, to the company's Waverly works at 796 Frelinghuysen Ave., Newark, New Jersey. This centralization of the executive, sales and production departments at one point is made in order better to serve the interests of the company's trade.

New Publications

VOCATIONAL EDUCATION FOR FOREIGN TRADE AND SHIPPING. Bulletin No. 24. Commercial Education Series No. 2 issued by the Federal Board for Vocational Education, Washington, D. C. Dated, November, 1918.

CALIFORNIA MINERAL PRODUCTION FOR 1917 WITH COUNTY MAPS. By Walter W. Bradley. Bulletin No. 83, dated August, 1918, issued by the California State Mining Bureau, San Francisco, Calif.

HYDRAULIC EXPERIMENTS WITH VALVES, ORIFICES, HOSE, NOZZLES, AND ORIFICE BUCKETS. By Arthur N. Talbot, Fred B. Seely, Virgil R. Fleming, and Melvin L. Enger in Bulletin No. 105, Vol. XV, No. 37, dated May 13, 1918, and can be procured from the Engineering Experiment Station, University of Illinois, Urbana, Ill., for 35c.

ANNUAL REPORT OF THE DIRECTOR BUREAU OF STANDARDS TO THE SECRETARY OF COMMERCE FOR THE FISCAL YEAR ENDED JUNE 30, 1918. Issued from the Government Printing Office, Washington, D. C.

ANNUAL REPORT OF THE CHIEF OF BUREAU OF FOREIGN AND DOMESTIC COMMERCE TO THE SECRETARY OF COMMERCE FOR THE FISCAL YEAR ENDED JUNE 30, 1918. Issued by the Government Printing Office, Washington, D. C.

NATURAL GAS: ITS PRODUCTION, SERVICE AND CONSERVATION. By Samuel S. Wyer of Columbus, Ohio. Bulletin 102, Part 7, issued by the Smithsonian Institution, United States National Museum, Washington, D. C.

NEW BUREAU OF MINES PUBLICATIONS: Bull. 157: Innovations in the Metallurgy of Lead. By D. A. Lyon and O. C. Ralston; Tech. Paper 192: Production of Explosives in the United States During the Calendar Year 1917. By A. H. Fay; Tech. Paper 206: Coke-oven Accidents in the United States During the Calendar Year 1917. By A. H. Fay; Bull. 129: The Fusibility of Coal Ash and the Determination of the Softening Temperature. By A. C. Fieldner, Albert E. Hall and Alexander L. Field; Tech. Paper 190: Methane Accumulations from Interrupted Ventilation in Coal Mines. By H. I. Smith and R. J. Hamon; Miners' Safety and Health Almanac for 1919, published in cooperation with the U. S. Public Health Service. Compiled by R. C. Williams; Eighth Annual Report by the Director of the Bureau of Mines to the Secretary of the Interior for the Fiscal Year Ended June 30, 1918.